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Literature Review Article

The potential role of probiotics in periodontal health

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Abstract

Introduction: Probiotics represent an area in which bacterial interaction with the hosts is being put to practical and therapeutic use. The mechanism of action of probiotics is related to its ability to compete with pathogenic microorganisms for adhesion sites, to antagonize these pathogens or to modulate the host's immune response. Therefore, changing the actual composition of plaque from an inflammatory cytokine-rich environment to a more benign environment dominated by neutral or even helpful organisms can contribute to overall systemic health. **Objective:** This non systematic review summarizes the currently available data on the potential benefits of probiotics for periodontal health. **Literature review:** Current and relevant references were selected in order to summarize the studies conducted so far on probiotics in preventing and treating oral infections. **Conclusion:** Probiotics as a treatment modality deserves to be explored further with long term studies with specific focus on its role in prevention.

Introduction

Bacteria have always been associated with disease and have caused the human race much grief. Hence the concept of harnessing bacteria for health benefits has a poetic ring to it. The concept of beneficial for health micro-organisms dates back to the ideas of Ukrainian Nobel laureate Ilya Metchnikov, working at the Pasteur Institute in Paris, during the early years of 20th century. Numerous investigations with probiotics have been undertaken since then and the final definition for the term "probiotics" was finally accepted in 2003. Probiotics are live microorganisms (in most cases, bacteria) that are similar to beneficial microorganisms found in the human gut. They are also called "friendly bacteria" or "good bacteria."

Experimental evidence shows that the microbiome is needed for the health of the host and that alterations in the ecological equilibrium of microbes can lead to disease. Therefore, it is logical to expect that the use of microbes that are members of the microbiome might help us restore balance [4]. We use the term "probiotics" to refer to microbes that are administered to produce beneficial effects on health, and the term "prebiotics" to indicate substrates that improve the growth or metabolic activities of particular indigenous organisms. Probiotics are not the same thing as prebiotics – nondigestible food ingredients that selectively stimulate the growth and/or activity of beneficial microorganisms already in people's colons. When probiotics and prebiotics are mixed together, they form a symbiotic.

The current article aims to review the beneficial role of some probiotic species, their mode of action and clinical effectiveness especially in periodontal disease and halitosis.

Literature review

The term "probiotic" was initially proposed by Lilley and Stillwell in 1965. The first probiotic species to be introduced in research was Lactobacillus acidophilus by Hull *et al.* in 1984; followed by *Bifidobacterium bifidum* by Holcombh *et al.* in 1991 [11]. Probiotics were then defined by FAO/WHO (The Food Agricultural Organization/World Health Organization) as live microorganisms which when administered in adequate amounts (in food or as a dietary supplement) confer a health benefit on the host (improving microbiological balance in intestinal tract) [3].

Current general medicine applications

Probiotics are available in foods and dietary supplements. Examples of foods containing probiotics are yogurt, milk and soy beverages. In probiotic foods and supplements, the bacteria may have been present originally or added during preparation.

Probiotics have proven to be effective in the treatment of several systemic and infectious diseases such as acute diarrhoea, Crohn's disease, cancer, immunodepressive states, inadequate lactase digestion, hyperlipidemia, liver diseases, infections with Helicobacter pylori, genitourinary tract infections and others [12].

Probiotics of interest for oral health

The widespread emergence of bacterial resistance to antibiotics has led to the concept of probiotic therapy for application in oral health. Dental caries, periodontal disease and halitosis are among the oral disorders that have been targeted. An essential condition for a microorganism to represent a probiotic of interest for oral health is its capacity to adhere to and colonize various surfaces of the oral cavity.

The most commonly used probiotic bacterial strains belong to the genera *Lactobacillus* and *Bifidobacterium*. *Lactobacilli* constitute about 1% of the cultivable oral microflora in humans. The species most often found in saliva are Lactobacillus acidophilus, *L. scasei*, *L. fermentum*, *L. plantarum*, *L. rhamnosus* and *L. salivarius*. The species found in dairy products are *L. acidophilus*, *L. casei*, *L. fermentum* and *L. rhamnosus* [5].

It has also been reported that people who consumed yoghurt containing *L. rhamnosus* on a daily basis host this microorganism in the saliva for up to 3 weeks after discontinuing yoghurt consumption [6].

Weissella cibaria (formerly classified in the genus *Lactobacillus*) secretes a significant quantity of hydrogen peroxide and a bacteriocin that acts against Gram-positive bacteria. It also has the capacity to coaggregate with *Fusobacterium nucleatum* and to adhere to epithelial cells. These properties could enable *W. cibaria* to effectively colonize the oral cavity and limit the proliferation of pathogenic bacteria [7].

Probiotics in periodontal disease

Periodontitis describes a group of related inflammatory diseases resulting in destruction of the tissues that support the tooth. It results from extension of the inflammatory process initiated in the gingiva to the supporting periodontal tissues. The main pathogenic agents associated with periodontitis are *P. gingivalis*, *T. denticola*, *T. forsythia* and *A. 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. The persistence of the host immune response also constitutes a determining factor in progression of the disease.

A study by Koll-Klais *et al.* showed higher prevalence of *lactobacilli*, particularly *L. gasseri* and *L. fermentum* in the oral cavity among

healthy participants than patients with chronic periodontitis. According to them high levels of Lactobacillus in microbiota caused an 82% inhibition in Porphyromonas gingivalis and 65% inhibition in Prevotella intermedia growth [9].

Patients with periodontal disease who used chewing gum or lozenges containing probiotics saw significant improvement in their periodontal status. Krasse et al. showed a significantly reduced gingival index and bacterial plaque amount in patients treated with L. reuteri incorporated in a chewing gum than in a placebo group and concluded that this probiotic was effective to reduce gingivitis and bacterial plaque deposition in patients with moderate-to-severe gingivitis [10].

Riccia *et al*. used lozenges incorporated with *L. brevis* to study its anti-inflammatory effects in a group of patients with chronic periodontitis. The study shows significant improvement not only in the plaque index, gingival index and bleeding on probing for all patients but also a significant reduction in salivary levels of prostaglandin E2 (PGE2) and matrix metalloproteinases (MMPs) [12].

Shimazaki *et al*. in an epidemiological study found that individuals, particularly nonsmokers, who regularly consumed yoghurt or beverages containing lactic acid exhibited lower probing depths and less loss of clinical attachment than individuals who consumed few of these dairy products. A similar effect was however not observed with milk or cheese [14].

A study by Teughels *et al*. addressed the hypothesis that the application of selected beneficial bacteria, as an adjunct to scaling and root planing, would inhibit the periodontopathogen recolonization of periodontal pockets. The study confirmed the hypothesis and provides a proof of concept for a Guided Pocket Recolonization (GPR) approach in the treatment of periodontitis [15].

Probiotics and halitosis

Halitosis has many causes (including periodontal disease, metabolic disorders, respiratory tract infections), but in most cases it is associated with an imbalance of the commensal microflora of the oral cavity. More specifically, halitosis results from the action of anaerobic bacteria that degrade salivary and food proteins to generate amino acids, which are in turn transformed into volatile sulphur compounds, including hydrogen sulphide and methanethiol [13].

Streptococcus salivarius was detected most frequently among people without halitosis and is therefore considered a commensal probiotic of the oral cavity. *S. salivarius* is known to produce bacteriocins which could contribute to reducing the number of bacteria that produce volatile sulphur compounds [1].

Discussion

The mouth represents the beginning of the gastrointestinal tract. Since probiotics have been used to successfully treat gastrointestinal diseases [12], an attempt can be made to use the same treatment with regard to oral diseases.

Several mechanisms have been proposed to explain how probiotics work:

- Probiotics can create a biofilm, which acts as a protective lining for oral tissues by keeping the bacterial pathogens away by filling a space pathogens would have invaded in the absence of the biofilm [2];
- Probiotics can also modify the surrounding environment by modulating the pH and/or the oxidation–reduction potential, which may compromise the ability of pathogens to become established;
- These bacteria secrete various antimicrobial substances such as organic acids, hydrogen peroxide and bacteriocins against oral pathogens [5];
- Probiotics may compete for adhesion sites with cariogenic bacteria and periodontal pathogens growth [5];
- Probiotics may compete for nutrients and growth factors [5];
- Probiotics may provide beneficial effects by stimulating nonspecific immunity and modulating the humoral and cellular immune response (enhance production of IgA and defensins) [5];
- Probiotics may reduce MMP production [5].

Few products containing probiotics (such as tablets, lozenges, chewing gums or tooth pastes) are currently available. Gum PerioBalance is the first probiotic marketed by Sunstar (Etoy, Switzerland), specifically formulated to fight periodontal disease. Gum PerioBalance contains a patented combination of 2 strains of *L. reuteri* specially selected for their synergistic properties in fighting both cariogenic bacteria as well as periodontopathogens. Each dose of lozenge contains at least 2 × 108 living cells of *L. reuteri Prodentis*. Users are advised to use a lozenge every day, either after meals or in the evening after brushing their teeth, to allow the probiotics to spread throughout the oral cavity and attach to the various dental surfaces. PerioBiotic™ (Designs for Health, Inc.,) tooth paste is an all-natural, fluoride-

free oral hygiene supplement containing Dental-Lac™, a functional *Lactobacillus paracasei* probiotic not found in any other toothpaste. Additional studies are however required to evaluate the long-term effects of using these products.

Conclusion

We live in a new era where creation of a harmonious relationship with our environment is well within the realm of possibility. The use of probiotics – living bacteria that have beneficial characteristics – is the perfect metaphor for this new approach. Although positive results have been obtained by some researchers, a significant amount of long term research needs to be carried out before probiotics can be advocated for every patient.

Future studies have to be aimed at not only identification of the probiotics that are best suited to oral therapy but also the most appropriate dose and vehicle for its dispensation.

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