



Probiotics and Periodontics: A Review

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ABSTRACT

Probiotics are defined as non-pathogenic live microorganisms which when administered in proper amounts imparts health benefits to the host. It has developed as an alluring area for research in recent time. There has been a change in treatment options from eliminating the specific bacteria to modulating the bacterial ecology by administering probiotics. Probiotics cater an fruitful and profitable means to treat periodontal disease. A complete knowledge of the ecologic changes in the oral cavity is necessary to compute their long term effects on oral health and disease. The paper reviews the documentation for the use of probiotics for maintaining the oral health and preventing periodontal disease.

Keywords: Probiotics, Lactobacillus, Bifidobacterium, Dental caries, Halitosis, Guided Pocket Recolonization.

INTRODUCTION

Mostly addressed as delicate microscopic specialty, periodontics has entered the saga of metamorphosis that explores and understands human body mechanisms at biomolecular levels¹. With the arrival of multiresistant strains, antibiotic resistance has become a problem and scientists are developing new means for fighting infectious diseases. There has been a major swing in treatment options from non specific to specific ones. Recent treatment options propose altering ecology of niches, in order to reorient pathological plaque to a biofilm of commensalisms².

A century ago, Elie Metchnikoff (a Russian scientist, Nobel laureate, and professor at the Pasteur Institute in Paris) hypothesized that lactic acid bacteria (LAB) offered health benefits proficient of boosting the survival rate. He advocated that “intestinal auto- intoxication” and the resultant aging could be suppressed by modifying the gut microbiota and replacing proteolytic microbes such as Clostridium which produce toxic substances including phenols, indoles, and ammonia from the digestion of proteins with useful microbes. He developed a diet with milk fermented with the bacterium he called “Bulgarian bacillus.”

Henry Tissier (Pasteur Institute) first isolated Bifidobacterium from a breast-fed infant, and he named the bacterium *Bacillus bifidus communis*. He claimed that bifidobacteria would displace the proteolytic bacteria that cause diarrhea and recommended the administration of bifidobacteria to infants suffering from this symptom.

The term probiotics was first introduced in 1965 by Lilly & Stillwell as substances produced by microorganisms which promote the growth of other microorganisms⁴. In 1989, Roy Fuller emphasized the requirement of viability for probiotics and introduced the idea that they have a beneficial effect on the host. Fuller in 1989, defined probiotics as an "A live microbial feed supplement which beneficially affects the host animals by improving its intestinal microbial balance"⁵. 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)⁶.

PROBIOTICS AND ORAL CAVITY

More than 700 species of oral microbiota have been detected in the human mouth and the resident microbiota of one individual may consist of 30-100 species⁷. The most significant requisite for a microorganism to be a probiotic is its ability to adhere and colonize the oral cavity.

Ideal Requisite of Probiotic Products-

- Should have high cell viability
- Should be non-pathogenic and non-toxic
- Should be able to withstand the oral environment conditions and defense mechanisms.
- Should be able to influence local metabolic activity

MECHANISM OF ACTION

Probiotics functions by direct and indirect mechanisms

1. DIRECT ACTION

- By interacting with the dental plaque it prevents the formation of plaque
- by emulating with the bacterial attachment seen on the surface of the tooth.

2. INDIRECT ACTION

- It acts by modifying the systemic immune system thus affecting the local immunity.
- It modulates the mucosal permeability and also functions as anti-oxidants.
- It neutralizes the free electrons, thus preventing the plaque formation.

HOW THEY ACT AGAINST PERIODONTAL DISEASES

INHIBITION OF SPECIFIC PATHOGENS-

- By preventing the pathogen adhesion, colonization and biofilm formation
- By preventing growth of the pathogens

EFFECT ON THE HOST RESPONSE-

- By inhibiting the collagenases , by decreasing the inflammation associated molecules and by expressing the cytoprotective proteins on host cell surfaces
- By regulating the pro-inflammatory pathways by pathogens
- By averting the cytokine induced apoptosis and by modulating the host immune response

IMMUNOLOGICAL BENEFITS OF PROBIOTICS-

- They activate the local macrophages and increase antigen presentation to B-lymphocytes
- They increases the immunoglobulin A production (IgA) both locally and systematically
- They regulate the cytokine profiles
- They actuate hyporesponsiveness to food antigens

NON-IMMUNOLOGICAL BENEFITS OF PROBIOTICS-

- They help in digesting the food and competing with the pathogens for the nutrients.
- They create a pH that is not suitable for the growth of pathogens
- They release bacteriocins which inhibits the growth of pathogens
- They scavenge superoxide radicals
- They cause epithelial mucin production
- They alter the pathogen-derived toxins

COMPOSITION OF PROBIOTICS

Probiotics are accessible as dietary supplements and foods that consist of yeast and bacteria. They are marketed as capsules, pastes, tablets, gels, packets, liquid or powders and are mostly in yoghurt or dairy drinks. Most commonly they are bacteria. Some of the species are-

1. Lactic Acid Producing Bacteria (LAB) –

- Lactobacillus acidophilus
- Lactobacillus bulgaricus
- Lactobacillus casei
- Lactobacillus crispatus
- Lactobacillus reuteri
- Streptococcus.

2. Non Lactic Acid Producing Bacteria Species –

- Bacillus cereus
- Propionibacterium
- Enterococcus faecalis
- Enterococcus faecium
- Escherichia coli Nissle

3. Non spore forming and non-flagellated rod or Coccobacilli

4. Non pathogenic yeast - Saccharomyces

5. Bifidobacterium species-

- B. adolescentis
- B. animalis
- B. bifidum
- B. breve
- B. infantis
- B. Lactis

STRAIN	BARND NAME
Lactobacillus casei DN-114 001	Actimel, DanActive
Lactobacillus casei F19	Cultura
Lactobacillus casei Shirota	Yakult
Lactobacillus reuteri DSM 17938	L. reuteri ,Protectis
Lactobacillus acidophilus CL1285 & L.casei Lbc80r	Bio K+
Bifidobacterium animalis DN 173 010	Activia
Bifidobacterium animalis subsp. lactis Bb-12	Chr. Hansen
Bifidobacterium breve Yakult	Bifiene
Bifidobacterium infantis 35624	Align
Bifidobacterium lactis HN019 (DR10)	Howaru Bifido
Enterococcus LAB SF 68	Bioflorin
Escherichia coli Nissle 1917	Mutaflor
Saccharomyces cerevisiae (boulardii) lyo	DiarSafe, Ultralevure

PROBIOTICS AND PERIODONTAL DISEASE

The studies conducted on Streptococcus uberis and Streptococcus oralis and other beneficial bacteria, has turned out to be helpful in inhibiting the growth of disease causing bacteria. Even the presence of Steptococcus oralis and Streptococcus Uberis has proved to be a good indication of healthy gingiva⁸. A study by Koll-Klais et al. revealed higher prevalence of lactobacilli, particularly Lactobacillus gasseri and Lactobacillus fermentum in the mouth of healthy individuals 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 growth⁹.

Chewing gum “PERIO BALANCE” is the first probiotic gum, designed to combat the periodontal disease. It is a combination of two strains of Lactobacillus reuteri having synergetic properties in inhibiting the cariogenic bacteria and periodontopathogens. Each dose of lozenge contains at least 2×10^8 living cells of Lactobacillus reuteri prodentis. Lozenge has to be used daily after meal or in the evening after brushing teeth, to allow probiotics to spread and adhere to various oral surfaces¹⁰. Krasse et al evaluated Lactobacillus reuteri in a recurrent gingivitis case. A parallel, double blind, randomized, placebo controlled study with 59

patients having moderate to severe gingivitis were selected. *Lactobacillus reuteri* strains were administered via chewing gums twice a day for 2 weeks at a concentration of 1×10^8 CFU along with scaling and root planing. After 2 weeks, the clinical parameters were improved in the group consuming probiotic chewing gums¹¹.

Hillman et al carried out a parallel open label placebo controlled study on 24 gnotobiotic rats including a single baseline application and showed significant decreased levels of *A. actinomycetem-comitans* when compared with placebo group¹².

Grudyanov et al using a mixture of probiotics, reported improvements in clinical signs of gingivitis. Probiotics have also been employed as antimutagenic and anticariogenic agents¹³.

PROBIOTICS AND HALITOSIS

Halitosis or bad breath is seen in large number of the population. It is caused by a number of volatile compounds originating from the oropharynx or from expired alveolar air. In halitosis, the sulphur containing gases (hydrogen sulfide, methyl mercaptan and dimethyl sulfide), derived from the bacterial degradation of sulphur containing amino acids in the oropharynx, are the main culprits.

Kang et al reported that *Weissella cibaria* has the capacity to coaggregate with *Fusobacterium nucleatum*, adhere to epithelial cells and produce hydrogen peroxide as well as bacteriocin which inhibits the proliferation of *F. nucleatum*. Gargling with a solution containing *Weissella cibaria* was associated with a net reduction in hydrogen sulphide production and consequently reduction in bad breath¹⁴.

Tomoyuki et al did a randomized controlled trial to evaluate the efficacy of *Lactobacillus salivarius* WB21 tablets in halitosis management and showed that oral malodor parameters significantly reduced at the end of 2 weeks of administration of the probiotic tablet compared to placebo tablets¹⁵.

PROBIOTICS AND DENTAL CARIES

Dental caries is one disease of the oral cavity that needs early care and prevention. *Streptococcus mutans* is one of main causative organism for dental caries. Numerous studies depict that the probiotics containing *Lactobacillus rhamnosus* GG and *Lactobacillus casei* or *Bifidobacterium* DN-173 010, reduce the growth of oral streptococci and dental caries risk¹⁶.

GUIDED POCKET RECOLONIZATION (GPR)

Recently, Teughels et al reported that the subgingival application of a bacterial mixture including *Streptococcus sanguinis*, *Streptococcus salivarius* (*S. salivarius*), and *Streptococcus mitis* after scaling and root planing significantly suppressed the recolonization of *Porphyromonas gulae* (canine *P. gingivalis*) and *Prevotella intermedia* in a beagle dog model¹⁷.

Vivekanad et al performed an animal study to test the concept of bacterial replacement therapy in the treatment of plaque related periodontal disease and assessed quantitative changes in the subgingival microbiota after root planing when beneficial bacteria were applied adjunctively. Although application of beneficial bacteria did not exclude pathogen recolonization, it did delay the recolonization process significantly¹⁸.

Nackaerts et al in an animal study evaluated radiologically the impact of replacement therapy by monitoring bone density changes and alveolar bone level in periodontal pockets in a dog model. The bone density within periodontal pockets treated with beneficial bacteria improved significantly after 12 weeks, there was a significant increase in the bone level at the end of the study for the pockets receiving beneficial bacteria, and no significant changes were noted in the control pockets¹⁹.

This concept of guided pocket recolonization if scrutinize and studied more can emerge as a treatment modality for periodontal diseases.

SAFETY ISSUES

Due to increased probiotics availability in different food products, safety measures are a major issue. Probiotics are often regarded as dietary supplements rather than as pharmaceutical products. When applied orally, a part of them will be ingested and interacts with a patient's health. When taken orally, they are generally considered safe and well tolerated with bloating and flatulence occurring frequently². The conclusions from antibiotic susceptibility tests showed that the tet- (W) and tet- (S) genes in some probiotic Lactobacilli and Bifido bacteria strains are responsible for sulfamethoxazole, gentamycin, polymyxin B and tetracycline resistance. These findings show the need of minimal safety evaluation during the selection of strains for probiotic use²⁰. The present literature suggests that the incidence of Lactobacillus bacteremia is uncommon and that all the cases where it has been registered are individuals with other systemic diseases such as diabetes, cardiovascular diseases, gastrointestinal disorders, malignancies, or organ transplant patients. Although administration of probiotics is safe and each strain of probiotics has its own properties that needs to be considered before using it in any patient.

CONCLUSION

Periodontitis is a risk factor of various systemic diseases like diabetes, atherosclerosis, preterm low birth and Probiotics presents a new era in periodontal therapy. The literature portrays that the use of oral probiotics improves the periodontal health. But the effect of Probiotics and its maintenance that includes administration, dosage and safety issues are not clear. NASA of USA is carrying out research to develop probiotic products which enable humans to live in space²¹. But further more randomized control trials are necessary to check for the efficacy of probiotics in management of periodontal diseases.

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