A Review on Probiotics and their Implications in Dentistry

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Abstract

The aim of this comprehensive review is to present an update about the current status of probiotics in terms of its application in the field of dentistry. The concept of administration of beneficial bacteria with a view to replace harmful microbes with useful ones has been revived by the probiotic concept. The main field of research has been in the gastrointestinal tract. However, past few years has seen investigation of probiotics from the oral health perspective. Probiotic approach has shown promising results in oral cavity with respect to control of chronic disease such as dental caries, periodontitis, and recurring problems like halitosis and candidial infections. The application of probiotic strategies may, in near future provide an end to many infections occurring in oral cavity. This article summarizes the currently available data on the potential benefits of probiotics for oral health and potential risks associated with them.

Key words: Probiotics, oral health


Introduction

The term Probiotic, meaning “for life,” is derived from the Greek language. This term was first used by Lilly and Stillwell in 1965 to describe substances secreted by one microorganism which stimulates the growth of another.¹ According to WHO (2002), Probiotics are “live microorganisms which, when administered in adequate amounts confer a health benefit on the host”. Probiotics have been used to improve gastrointestinal health for quite some time and their popularity has prompted increased interest for their role in promotion of oral health. There also has been a change in understanding of the oral disease process because of better understanding of ecology and microbiology of oral cavity. Very encouraging studies have come up in recent past exploring probiotics in fields of caries, periodontal diseases and few other areas and the results tend to suggest beneficial effects of probiotics on oral health and on whole body in general.

This article summarizes currently available data on the potential benefits of probiotics for oral health.

Historical Facts

There is a long history of health claims concerning living microorganisms in food, particularly lactic acid bacteria. In a Persian version of the Old Testament it states that “Abraham owed his longevity to the consumption of sour milk”. In 76 BC the Roman historian...
Plinius recommended the administration of fermented milk products for treating gastroenteritis. Elie Metchnikoff was perhaps the first researcher to propose that fermented dairy products have beneficial properties. In 1894, he showed that cholera could be prevented by the presence of antagonistic organisms in the intestine. In 1907 the Ukrainian-born biologist and Nobel laureate, working at the Pasteur Institute in Paris, discovered Lactobacillus bulgaricus. He developed a theory that lactic acid bacteria (present in Bulgarian yoghurt) in the gastrointestinal tract could, by preventing putrefaction, prolong life. This was based on his observation that Bulgarians lived longer than other people. He devoted the last decade of his life to the study of lactic acid-producing bacteria as a means of increasing human longevity. The concept of probiotics was thus born and a new field of microbiology was opened.

**Ideal Requirement of a Probiotic**

It should be:

- Non toxic and non pathogenic
- Having beneficial effects
- Able to withstand gastrointestinal juices
- Replace and reinstate the flora

**Therapeutic Actions of Probiotics**

The major areas of their therapeutic clinical action include:

- Prevention of diarrhoea caused by clostridium difficile
- Prevention of colon cancer.
- Reduces progression of AIDS.
- Enhancement of calcium absorption.
- Regulation of Immunity.
- Compete against harmful microorganisms, preventing colonization of pathogens.
- Reduction of blood cholesterol levels.
- Reduction of liver toxicities.
- Enhancement of vitamin status (B, K).
- Increases the lifetime of voice prosthesis.

**Probiotic Species for Oral Health**

Probiotics can be varied. They can be yeast, bacteria or moulds. But most commonly, bacterial species are predominant. Some of the species are:

1. Lactic acid producing bacteria (LAB): Lactobacillus, bifidobacterium, streptococcus
2. Non lactic acid producing bacterial species: Bacillus, propionibacterium
3. Non pathogenic yeasts: Saccharomyces
4. Non spore forming and non flagellated rod or coccrobacilli

**Mechanism of Probiotics in Oral Health**

The suggested mechanisms of probiotic action on oral health are drawn entirely from gastrointestinal studies. Several mechanisms have been suggested to contribute to the probiotic action in systemic health. They relate to immune modulation, modulation of gut immunological mechanisms, mucin production, down regulation of inflammatory responses, secretion of antimicrobial substances, competition with other flora, including potential pathogens by competitive blocking of adhesion sites at epithelial and mucosal surfaces, and inhibition of epithelial invasion by regulation of intestinal permeability, inhibition of pathogens mucosal adherence and stimulation of immunoglobin A production. There is also evidence of production of antimicrobial substances, such as organic acids, hydrogen peroxide and bacteriocins. Their applicability to oral health needs further studies. Nevertheless, since the mouth represents the first part of the gastrointestinal tract, there is every reason to believe that at least some probiotic mechanisms may also play a role in that part of the system. It may also be anticipated that resident probiotics could exist in the oral microflora, and that they may function in the complex ecosystem of dental plaque and in the formation and development of oral biofilms in general.
Effect of Probiotics on Oral Health
Probiotics and Dental Caries\textsuperscript{10,11}

Streptococcus mutans is the main microorganism involved in causation of dental caries. Probiotics can reduce the risk for a high Streptococcus mutans (S. mutans) level occurrence. Bacteria administered as probiotics compete with cariogenic microbes for adhesion sites as well as for nutrients and growth factors leading to reduced level of S. mutans in oral cavity. Çaglar et al. in a comparative study of S. mutans reduction effects by several probiotic administration forms, showed a reduced S. mutans level in patients receiving fluid or tablet probiotic forms. Nikawa et al. reported that consumption of yoghurt containing Lactobacillus reuteri (L. reuteri) over a period of 2 weeks reduced the concentration of S. mutans in the saliva by up to 80%. Comparable results were obtained by incorporating probiotics into chewing gum or lozenges. These promising results suggest a potentially beneficial application of probiotics for the prevention of dental caries.

Probiotics and Halitosis\textsuperscript{11,12}

Halitosis or bad breath is a condition affecting comparatively large section of population. Bad breath in oral cavity is mainly ascribed to the production of volatile sulfur compounds (VSC) predominantly by gram negative anaerobes residing in periodontal pockets and on the dorsal surface of tongue. The replacement of bacteria implicated in halitosis by colonization with probiotic bacterial stains may have potential application as adjuncts for the prevention and treatment of halitosis.

A definite inhibitory effect on the production of volatile sulfur compounds (VSC) by F. nucleatum was observed after ingestion of Weissella cibaria both in vitro and in vivo. In children, a marked reduction in the levels of H2S and CH3SH was registered after gargling with W. cibaria containing rinse. The possible mechanism in the VSC reduction is the hydrogen peroxide generated by W. cibaria that inhibits the proliferation of F. nucleatum. Streptococcus salivarius, also a possible candidate for an oral probiotic, has demonstrated inhibitory effect on VSC by competing for colonization sites with species causing an increase in levels of VSC.

Although various probiotic products are marketed for both mouth and gut associated halitosis, their efficacy demands more clinical studies.

Probiotics and Periodontal Disease:\textsuperscript{12, 13}

Mucosal immune responses may be invoked by probiotic immunization. Studies of adhesion molecules have shown that superficial cell layers of the gingiva can be affected and can be stimulated to enhance the presence of immune poten cells. Regulation of microflora composition (e.g. by probiotics and prebiotics) may offer the possibility to influence the development of mucosal and systemic immunity, but it can also play a role in the prevention and treatment of diseases such as periodontitis. In a Russian study using probiotic tablets in complex treatment of gingivitis and different degrees of periodontitis, the effect of probiotics to the normalization of microflora was found to be higher in comparison to the controls, particularly in the cases of gingivitis and periodontitis. A decrease in gum bleeding and reduced gingivitis has been observed with the application of L. reuteri. Probiotic strains included in periodontal dressings at optimal concentration were shown to diminish the number of most frequently isolated periodontal pathogens: Bacteroides sp., Actinomyces sp. and S. intermedius, and also C. albicans. Nevertheless, similar to the case with dental caries, however, there is not yet any true evidence on the effect of probiotic therapy on periodontal disease.

Probiotics and Candidiasis\textsuperscript{12,14}

A reduction in the prevalence of Candida Albicans in the elderly after consumption of probiotic cheese containing L. rhamnosus and propionibacterium has been demonstrated.

This is the only study that has been published in human population and the authors didn’t have any explanation to this and further investigations are needed.

Future Directions

Recently, oral lactic acid bacteria and bifidobacteria have been isolated and characterized for various oral health purposes, including caries, periodontal diseases, and
halitosis. The new probiotic products targeted for oral health purposes do not necessarily comprise the same species as products now in market. Genetically modified microbes bring a new dimension to the concept of probiotics. Their main thrust is on reducing the harmful properties of pathogenic strains naturally colonizing the oral cavity. The modified strain could then be used to replace the original pathogen. Also they could be used to enhance the properties of a potentially beneficial strain. In field of oral immunology, probiotics are being used as passive local immunization vehicles against dental caries. Bacteriophages, viruses that kill bacteria, have been detected in oral pathogens, such as Actinobacillus actinomycetemcomitans, and they may play a role in the pathogenicity. Subsequently, future studies should be conducted to investigate if phage therapy might be applied for oral and dental diseases in the same way as has been attempted for systemic infections. The selection of the best probiotic for oral health is also an issue that calls for further study. 

**Conclusion**

Probiotics are emerging as a fascinating field in oral medicine. This concept prompts a new horizon on the relationship between diet and oral health.

Clinical trials should be directed to assess the method of probiotic administration in oral cavity and dosages or different therapeutic uses. Research should be directed towards the action of probiotics on oral cavity and also on its pathological conditions.

**REFERENCES**