

Role of Probiotics in Oral Health: A Review**Gagandeep Kaur , Padmavathi B.N., S.Y. Rajan, Darshna Chowdhury**

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ABSTRACT:

Probiotics are beneficial microorganisms and habitat in our body with other commensal flora. Probiotics have been found to be beneficial to host health. In recent years, probiotics have been used as a treatment to promote oral health. The article reviews studies reporting the anti-cariogenic effects of probiotics, their use in the treatment of periodontal disease, as well as their use in the treatment of halitosis were identified. The studies done by authors point towards the improvement of oral health with the use of probiotics. Also, there was significant reduction in levels of cariogenic, periodontal pathogens and halitosis.

Keywords: Cariogenic, Halitosis, Oral health, Probiotics, Periodontal pathogens.**INTRODUCTION**

Probiotics are defined as “live microbial feed supplements which beneficially affect the host animal by improving its intestinal microbial balance” (Fuller, 1994).¹

The first recorded probiotic was fermented milk for human consumption.² The probiotic microorganisms consist mostly of the strains of the genera *Lactobacillus* and *Bifidobacterium*, but strains of *Bacillus*, *Pediococcus* and some yeasts have also been shown to be useful.³ The use of health beneficial micro-organisms to heal diseases or support immune function was first introduced in the beginning of the 20th century.

The immensely efficient innate host defence system constantly monitors the bacterial colonization and prevents bacterial invasion of local tissues. Since a defective steadiness exists between dental plaque bacteria and the innate host defence system, probiotics have been used as a treatment to promote oral health in recent years.⁴

DISCUSSION

The use of Probiotics have been recently advocated in dentistry for management of conditions like dental caries, periodontal

infections, fungal infections and halitosis.⁵ Probiotics are available in the form of lozenges, tablets, solutions, capsules, yogurt drinks.⁶ (Table 1)

Dental caries management

Dental caries is a multifactorial disease, particularly having a bacterial etiology, which results in acid demineralization of the tooth enamel. It is mainly composed of streptococci belonging to the mutans group. For a probiotic to have a beneficial effect, it must be able to adhere to dental surfaces and interact with bacteria present, thereby leading to formation of a biofilm on teeth. It must also compete with and antagonize the cariogenic bacteria and thus prevent their proliferation. Probiotics can neutralize the acidic material, for which reason, they are used in dairy industry.^{7,8}

The mutans species of *Streptococcus* produces water insoluble mutan which helps in biofilm formation. It also has acidogenic properties and capable of rapidly metabolising sugar that produces low pH, which can further lead to caries. It has been seen that the lesser the count of *S. mutans*, less is the risk of caries. To execute this, several studies has been done to

show how probiotics suppress the growth of *S. mutans* bacteria in the oral cavity.⁹

Table 1: *Different means of administration for oral health purposes*

VEHICLE	STRAIN	OUTCOME
Lozenge	<i>S.salivarius</i>	Reduces oral volatile sulphur compound levels
Straw, tablet	<i>L.reuteri</i> ATCCC 55 730	<i>S.mutans</i> level reduction
Cheese	<i>L.rhamnosus</i> GG; <i>Prorionibacterium</i> JS	Reduced risk of high yeast counts and hyposalivation
Rinse solution	<i>W.cibaria</i>	Reduction of volatile sulfur compounds
Capsule, liquid	<i>L.sporogenes</i> , <i>L.bifidum</i> , <i>L.bulgaricus</i> , <i>L.thermophilus</i> , <i>L.acidophilus</i> , <i>L.casei</i> , <i>L.rhamnosus</i>	Increased salivary counts of lactobacilli without significant decrease in <i>S.mutans</i> counts
Yogurt drink	<i>L.rhamnosus</i> GG	Temporary oral cavity colonization

A placebo controlled double blind intervention study was conducted by Nase et al. where they administered the probiotic lactobacilli (LGG) to kindergarten children in Helsinki, Finland. The result was the reduction of caries risk in children. The study was performed on 594 children, 1–6 yr old, and they received the probiotic milk or normal milk with meals from coded containers 5 days per week for 7 months. The results showed less dental caries in the LGG group and lower *mutans* streptococci counts at the end of the study. Thus, they conclude that the milk containing the probiotic LGG bacteria may have beneficial effects on children's dental health.^{7,10,11}

In Finland, Ahola et al. carried out a study where they did comparative evaluations of health benefits between cheese containing *L. rhamnosus* GG and *L. rhamnosus* LC 705 and cheese without these probiotic strains. Their study was a randomized, double-blind, controlled study with two parallel groups. The daily dose was 15 g five times a day. *S. mutans* counts after the 3-week intervention period and at 3 weeks post-treatment were recorded. The results showed that *S.mutans* count decreased in the group who received probiotic intervention.¹⁰

Based on the caries-preventive effects of *L. rhamnosus* GG, Nikawa et al. examined the effects of *L. reuteri*-containing yogurt on the oral carriage of *mutans* streptococci. Their results suggest that *L. reuteri* in yogurt reduces the *S. mutans* levels in saliva for at least up to 2 weeks after discontinuing the consumption.^{7,10}

Recently, Petti and colleagues mentioned the benefits of *S. thermophilus* and *L. bulgaricus* in the yogurt, citing their bactericidal effects on the *mutans* group.⁷

Bacterial periodontal infections

Periodontal disease is classified into 2 types: Gingivitis and Periodontitis.

The main pathogenic agents associated with periodontitis are *P. gingivalis*, *Treponema denticola*, *Tannerella forsythia* and *Aggregatibacter actinomycetemcomitans*. These bacteria result in tissue damage by colonizing the subgingival sites.

In one recent study, it was shown that the lactobacilli count was inversely proportional to the extent of periodontitis. Strains such as *Lactobacillus gasseri* and *L. fermentum* have shown to inhibit the growth of periodontopathogens in the oral cavity.^{7,12}

When patients suffering from various periodontal diseases were treated with a culture supernatant of a *L. acidophilus* strain, they showed a marked recovery.

Plaque-related periodontal inflammation of the gingiva has been related to number of beneficial bacteria. It was proposed that, restoring these reduced numbers of beneficial bacteria through use of probiotics might help in improvement of gingiva caused by plaque.

In the recent times, the appreciation of the beneficial oral microbiota and their use in the prevention and treatment of plaque related periodontal inflammation has undergone a revival. In Japan, an *L. salivarius* strain is currently being investigated regarding its potential to suppress periodontal pathogens and improve periodontal health.

Krasse et al. did a double blind, randomised, placebo-controlled study, wherein they enrolled patients with moderate to severe gingivitis. Probiotic group were given chewing gum with *L.reuteri* strain and placebo group were given same chewing gum nut without the strain. The patients were instructed to use a chewing gum twice a day for 2 weeks, after which gingival and plaque scores were recorded. The gingivitis and plaque scores were reduced for probiotic group but not for the placebo group. Hence, Krasse et al. concluded that *L.reuteri* is helpful in reducing gingivitis and plaque scores.^{7,10}

Riccia and colleagues recently in their study showed that *Lactobacillus brevis* has an anti-inflammatory effect in chronic periodontitis patients. They made the participants to suck on lozenges containing *L.brevis* and found that there was reduction in salivary levels of prostaglandin E2 (PGE2) and matrix metalloproteinases (MMPs). Also, stating that clinical parameters like gingival index, plaque index improved. According to authors, this might be due to capacity of *L.brevis* to prevent the production of nitric oxide which further affects the release of prostaglandins and activation of MMPs.

Recently, Shimazaki and colleagues used epidemiological data to assess the relationship

between periodontal health and the consumption of dairy products such as cheese, milk and yogurt. They arrived at a result that individuals who regularly consumed yogurt or beverages containing lactic acid exhibited lower probing depths and less loss of clinical attachment than individuals who consumed few of these dairy products. Longitudinal studies are required, however, to prove a relationship between regular consumption of products containing probiotics and periodontal health.⁷

Teughels and co-workers examined seven presumed beneficial oral bacteria for their ability to interfere with the colonization of periodontal pathogens. The bacterial strains lead to inhibition of colonization of periodontal pathogens. This inhibition was partially caused by direct inter-bacterial interactions, environmental conditioning and interaction with epithelial cells.¹⁰

Fungal infections

Elahi et al. conducted a study on oral cavity of miceto study the clearance rate of *Candida albicans* from oral cavity following the oral administration of *L. acidophilus* and *L. fermentum* strains. They found rapid decline in colonization levels of *Candidia* species.

Hatakka et al. were the first to perform a randomized, double-blind, placebo-controlled study on the effect of probiotics on the prevalence of oral candida. They included elderly people (age 70–100 years in the study). The elderly were selected for this study because they are vulnerable to candida infection. One group consumed probiotic cheese, containing *Lactobacillus lactis* and *Lactobacillus helveticus* strains. Another group consumed cheese without these strains. Microbiological samples were taken by swabbing the oral soft tissues with a cotton swab. An increase of salivation in the probiotic group compared to control group was noted. As reduced salivary flow is a risk factor for candida infection in the elderly,¹³ they conclude that it might well be that the reduction in prevalence of high candida levels

in the probiotic group is a reflection of the change in the salivation. However, further investigations are required to back this effect.

Halitosis

Burton et al. investigated the effect of *S. salivarius* on oral malodour parameters. Since the bacterial populations on tongue are responsible for halitosis, the first line of treatment for oral malodour is the reduction of these bacterial populations. This is usually achieved by use of a variety of antimicrobial agents or mechanical devices. However, it is a short term treatment as oral malodour recurs as soon as the bacteria reappear. So, in their study used a broadly-active antimicrobial (chlorhexidine) for temporary depletion of the oral microbiota and then repopulated the tongue surface with a commensal strain of *Streptococcus salivarius* K12. When measured after 1 week of using the K12 lozenges, the volatile sulphur readings were reduced by at least 100 ppb when compared with pretreatment levels. Also, all subjects showed an increase in the levels of *S. salivarius* as a proportion of their total salivary populations and other measures of halitosis such as BANA reactivity and organoleptic scores were reduced (Burton et al, 2004). It can be stated that the bacteriocins produced by strain K12 may have hampered re-growth of key microbial participants in the halitosis-associated ecosystem.¹⁴⁻¹⁷

Tomoyuki et al. conducted a study to evaluate whether oral administration of lactobacilli alters the degree of halitosis and clinical conditions associated with the halitosis. They concluded that physiologic halitosis was improved. Also, beneficial effects on bleeding on probing from the periodontal pocket were noted.¹⁸

The oral cavity with its diversity of microbial species has been shown to harbour strains also distinguished as probiotics. In this regard, further studies identifying resident probiotics of the mouth, clarifying the mechanism of their colonization, and the eventual effect on the oral environment are needed.¹⁰ Studies

have shown health benefits when probiotics were inculcated in dairy products where they neutralize acidic conditions and hamper the growth of cariogenic bacteria. Also, improvement has been shown in patients with chronic periodontitis and oral malodour post treatment with probiotics. However further studies are required to for more appropriate identification of the probiotics that are best suited to oral use as well as the most suitable vehicles such as food products (cheese, milk, yogurt) or supplement (chewing gum, lozenge).⁷

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