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Probiotic treatment in the oral cavity: An update

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Abstract

Probiotics have been found to be beneficial to host health. Their primary use in medicine has been for the management of intestinal tract problems.

In recent years, probiotics have been used as a treatment to promote oral health. The aim of the present study was to review published studies regarding probiotics and their effects on the oral cavity. Studies reporting the anticariogenic effects of probiotics, their use in the treatment of periodontal disease, a reduced crevicular fluid volume and cytokine content, as well as their use in the treatment of halitosis and *Candida albicans* were identified. Studies assessing residence time of probiotics in the oral cavity were also selected for retrieval. Most authors concluded that the use of oral probiotics was associated with an improvement in oral health, including a significantly reduced level of cariogenic and periodontal pathogens and a lower crevicular fluid volume and cytokine concentration.

Key words: Probiotics, oral health, cariogenic bacteria, periodontal disease, halitosis, *Candida albicans*.

Introduction

Probiotics were 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) (1,2). Such non-pathogenic organisms (yeasts or bacteria, particularly lactic acid bacteria) are present in food, and can have

a favorable impact on host health. Probiotics have been used for decades in fermented products, but potential use of probiotics as a nutritional medical therapy has not been formally acknowledged (2).

Metchnikoff was the first to state that probiotics could provide a health benefit, and proposed that Bulgarian people had a longer longevity due to fermented milk containing viable bacteria. "Probiotic" term, as opposed to "antibiotic", was initially proposed by Lilley

and Stillwell in 1965. First probiotic species to be introduced in research was *Lactobacillus acidophilus* by Hull et al. in 1984; followed by *Bifidobacterium bifidum* by Holcomb et al. in 1991 (3).

Probiotics can improve patient condition in medical disorders such as diarrhea, gastroenteritis, short-bowel syndrome, and inflammatory intestinal diseases (Crohn's disease and ulcerative colitis), cancer, immunodepressive states, inadequate lactase digestion, pediatric allergies, growth retardation, hyperlipidemia, liver diseases, infections with *Helicobacter pylori*, genitourinary tract infections, and others; all such findings have been supported by several studies demonstrating improved results after using probiotics (2-4).

Currently available information on oral probiotic uses, such as therapy for oral cavity disorders including tooth decay or periodontal disease, is scarce. The aim of the present study was to update such information based on studies assessing probiotics effects in oral cavity. A literature search in Pub-Med database was performed for English- or Spanish-language articles, using the following search terms: "probiotics" and "oral health"; no restrictions were used for publication dates.

Mechanism of action of probiotics in oral cavity

In oral cavity, probiotics can create a biofilm, acting as a protective lining for oral tissues against oral diseases. Such a biofilm keeps bacterial pathogens off oral tissues by filling a space pathogens would invade in the absence of the biofilm (4); and competing with cariogenic bacteria and periodontal pathogens growth (5).

Probiotics and cariogenic pathogens

Probiotics can reduce the risk for a high *Streptococcus mutans* level occurrence (6-8). An *in vitro* study has suggested *Lactobacillus rhamnosus GG* can inhibit colonization by streptococcal cariogenic pathogens, and therefore reduce tooth decay incidence in children (7). Näse et al. (6) reported a reduced tooth decay incidence in children taking probiotic *L. rhamnosus GG*-enriched milk versus a control group of children taking milk without probiotic enrichment. Similar findings were observed by Ahola et al. (7) after administering the same probiotic. Nikawa et al. (8) showed that bovine milk fermented with *Lactobacillus reuteri* was effective against *S. mutans*, resulting in a reduced risk for tooth decay. Unlike Meurman et al. (9) and Nikawa et al. (8), Montalto et al. (10) reported an increased amount of *Lactobacillus* in saliva, with no reduction of *S. mutans* level, when administering to their patients *Lactobacillus* in a fluid form or in capsules to assess systemic effects. Also, Çağlar et al. (11), 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. In an-

other study by Çağlar et al. (12), *S. mutans* reduction effects were compared in subjects using probiotics-, xylitol-, or probiotics plus xylitol-enriched chewing gums, and a placebo control group; a reduced *S. mutans* level was observed in subjects using probiotics- or xylitol-enriched chewing gum; no synergic effect was seen when combining both agents. In another study by Çağlar et al. (13) probiotics effects were assessed after administration in a pacifier including a tablet that was dissolved in mouth after a 10 to 12-minute suction; a reduced *S. mutans* level versus control group was found. Effects of an ice-cream containing *Bifidobacterium lactis* on *S. mutans* and *Lactobacillus* level in saliva were assessed by Çağlar et al. (14); a significantly reduced level was observed for *S. mutans*, but not for *Lactobacillus*. Effects of lactic strains used as probiotics in oral cavity were evaluated by Comelli et al. (5); *Streptococcus thermophilus* and *Lactococcus lactis* strains were shown to reduce cariogenic bacteria levels (particularly *Streptococcus sobrinus* and also *Streptococcus oralis*, *Actinomyces naeslundii*, and *Veillonella dispar*).

Probiotics and periodontal disease

The effect of probiotics tablets on gingivitis and different grades of periodontitis was studied by Grudianov et al. (15); probiotics treatment resulted in better microbiota normalization than control group. Krasse et al. (16) showed a significantly reduced gingival index and bacterial plaque amount in patients treated with *L. reuteri* 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. According to Koll-Klais et al. (17), high levels of *Lactobacillus* in microbiota caused an 82% and 65% inhibition in *Porphyromonas gingivalis* and *Prevotella intermedia* growth, respectively.

Twetman et al. (18) used *L. reuteri*-containing chewing gum in 42 healthy patients and assessed its effects on crevicular fluid volume, cytokine (interleukin-1 β , interleukin-6, interleukin-10, and TNF- α) levels, and bleeding on probing. Crevicular fluid volume, as well as TNF- α and interleukin-8 levels, and bleeding were significantly reduced.

Probiotics and halitosis

Regular use of probiotics can help to control halitosis. After taking *Weissella cibaria*, reduced levels of volatile sulfide components produced by *Fusobacterium nucleatum* were observed by Kang et al. (19); the effect could be due to hydrogen peroxide production by *W. cibaria*, causing *F. nucleatum* inhibition. *Streptococcus salivarius* also suppress volatile sulfide effects, by competing for colonization areas with volatile sulfide-producing species (20).

Probiotics and *Candida albicans*

C. albicans is a leading cause of infection in oral cavity; it is particularly common in the elderly and in immunocompromised patients. Hatakka et al. (21) showed a reduced prevalence of *C. albicans* after taking probiotics in cheese containing *L. rhamnosus* GG and *Propionibacterium freudenreichii* ssp. *shermanii* JS. Results obtained by Koll et al. (22) when assessing the effects of various *Lactobacillus* strains in oral cavity were markedly different; most strains suppressed growth of periodontal pathogens, including *Aggregatibacter actinomycetemcomitans* (60 out of 67 tested strains); *Porphyromona gingivalis* (35 out of 42 strains), *P. intermedia* (26 out of 42 strains), and cariogenic *S. mutans* (37 out of 67 strains). No inhibition was found, however, for *C. albicans* growth.

Residence time of probiotics in oral cavity

Residence time of probiotics in oral cavity after treatment withdrawal was studied by Çağlar et al. (11). A reduced *S. mutans* level was shown after a two-week use of a *L. reuteri*-enriched yogurt; effects were observed during use and for a few days after discontinuation. A loss of *L. reuteri* colonization was observed by Wolf et al. (23) two months after having discontinued probiotic use. *L. rhamnosus* GG administration and oral cavity colonization was studied by Yli-Knuutila et al. (24); the authors concluded that permanent colonization in oral cavity was unlikely (although possible in some cases) and suggested the probiotic to be used on a regular basis. Binding strength of 17 *Lactobacillus* strains and 7 bifidobacteria strains to saliva and oral mucous membrane was variable in different strains, according to a study by Haukioja et al. (25); such a strength variation caused an increased residence time of probiotic in oral cavity. Latency time of probiotic *S. salivarius* K12, 4 tablets/day for 3 days, was assessed in several oral cavity areas in a 35-day follow-up, by Horz et al. (26); probiotic could be found on oral mucous membrane, tongue and in stimulated saliva for more than 3 weeks, with a gradually reduced *S. salivarius* K12 level being detected beginning 8 days after treatment withdrawal.

Comments

A literature review shows that oral probiotics use is associated to an improvement in oral health, which is mainly due to significantly reduced levels of cariogenic as well as periodontal pathogens; volume and cytokine levels are also reduced. Nevertheless, further studies will be needed to show probiotics efficacy to improve oral health.

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