



Probiotics and Oral Health

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ABSTRACT

Not all the bacteria in the human body are harmful. Some microbes have a beneficial health effects on the host. Such live microbes are known as probiotics. This term 'probiotic' is derived from the Greek word meaning 'for life'. There are claims that probiotics strengthen the immune system to combat allergies, exposure to toxic substances, stress and other diseases. The use of probiotic plays an important aspect in dentistry too ever since the oral infections occupied the prime space among the other infections effecting the humans. Their use in premalignant and malignant oral disorders is yet to be probed. This article will focus on benefits of probiotics for systemic and oral health.

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INTRODUCTION

Probiotics are the subject of intense and widespread research in food and nutritional science. Probiotics can be described as live microorganisms which when administered in adequate numbers confer a health benefit on the host.¹ United Nation's Food and Agricultural Organization (FAO) and the World Health Organization (WHO) defined probiotics as living microorganisms, principally bacteria that are safe for human consumption and when ingested in sufficient quantities, have beneficial effects on human health, beyond basic nutrition.² Initially, probiotics were associated with gut health but during the last decade, an increasing number of established and proposed health effects of probiotic bacteria have been reported, which include enhancement of the adaptive immune response, treatment or prevention of urogenital and respiratory tract infections, and alleviation or prevention of allergies and atopic disease in infants. Recently, beneficial effects of probiotics on oral health have been suggested.³ Prebiotics are nondigestible food ingredients,

such as fructooligosaccharides (FOS), lactulose and inulin that beneficially affect the host by selectively stimulating growth and/or increase activity of a limited number of probiotic like bacteria in colon.⁴ This review is aimed to discuss the role of probiotics in the oral cavity.

HISTORY

The use of microorganisms to promote health is very ancient and can even be traced back to the classical Roman literature where food fermented with microorganisms was used as a therapeutic agent.⁵ In a Persian version of the Old Testament (Gn 18, 8), it states that 'Abraham owed his longevity to the consumption of sour milk'. 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.¹ It was in the first decade of 1900, in the beginning of the 20th century when the Ukrainianborn Nobel prize laureate Elie Metchnikoff observed the positive beneficial effect of some bacteria on the human health and suggested that these beneficial bacteria can be used to replace harmful microbes in the body. Metchnikoff worked at the Pasteur Institute in Paris and had discovered *Lactobacillus bulgarius*, a strain which he later on introduced into commercial production of sour-milk products in France and throughout Europe. He dedicated the last decade of his life to the study of lactic-acid producing bacteria as a means of increasing human longevity.⁶ In 1984, Hull identified the first probiotic species, i.e. the *Lactobacillus acidophilus*. Then in 1991, Holcomb identified another species bifidobacterium bifidum. In 1994, WHO described the probiotics as next most important in immune defence system following antibiotic resistance.⁷ 'Probiotic' term, as opposed to 'antibiotic', was proposed in 1965 by Lilley and Stillwell.⁸

DEFINITION

Probiotics are defined as 'live microorganisms, which when administered in adequate amounts, confer a health benefit on the host'.⁶

MECHANISM OF ACTION OF PROBIOTICS

The mechanisms by which probiotics exert their effects are largely unknown, but may involve modifying

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pH in gut, production of antimicrobial compounds for antagonizing pathogens, competing for pathogen binding and receptor sites and for available nutrients and growth factors, stimulating immune modulatory cells, and lactase production. Probiotic bacteria have been shown to influence the immune system through several molecular mechanisms.⁹

MECHANISM OF ACTION IN ORAL CAVITY

- Prevention of adhesion of pathogens to host tissue, i.e. binding to dental surfaces.
- Stimulation and modulation of the mucosal immune system, e.g. by reducing production of proinflammatory cytokines through actions on NFκB pathways, increasing production of anti-inflammatory cytokines, such as IL-10 and host defence peptides, such as β-defensin 2, enhancing IgA defences and influencing dendritic cell maturation.
- Modulation of cell proliferation and apoptosis through cell responses, e.g. microbially produced short chain fatty acids.
- Improvement of intestinal barrier integrity and up-regulation of mucin production.
- Killing or inhibition of growth of pathogens by production of bacteriocins or other products, such as peroxide or acid, which are antagonistic to pathogenic bacteria.
- Involvement in binding of oral microorganisms to proteins (biofilm formation).
- Action on plaque formation and on its complex ecosystem by competing and intervening with bacteria-to-bacteria attachments.
- Involvement in metabolism of substrates (competing with oral microorganisms of substrates available).
- Alteration of environmental conditions of oral cavity.^{10,11}

PROBIOTIC SPECIES FOR ORAL HEALTH

Probiotics can be varied. They can be bacteria, yeast or molds. Some of the species are as follows:

- Lactic acid producing bacteria (LAB): *Streptococcus*, *Bifidobacterium* and *Lactobacillus*.
- Nonlactic acid producing bacterial species: *Propionibacterium* and *Bacillus*.
- Nonpathogenic yeasts: *Saccharomyces*
- Non spore forming and nonflagellated rod or coccobacilli.¹²

PROBIOTICS PRODUCTS

Probiotics can be provided in products in four basic ways as follows:

1. A culture concentrate added to a food or beverage (such as a fruit juice).

2. Inoculated into prebiotic fibers.
3. Inoculants into a milk-based food (dairy products, such as milk, milk drink, yogurt).
4. Yogurt drink, cheese, kefir, biodrink [as concentrated and dried cells packaged as dietary supplements (nondairy products) (such as powder, capsule, gelatin tablets)].¹

THERAPEUTIC ACTIONS OF PROBIOTICS

- Prevention of diarrhea 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
- Blood cholesterol levels reduction
- Reduction of liver toxicities
- Enhancement of vitamin status (B, K)
- Increases the lifetime of voice prosthesis.¹²

EFFECTS OF PROBIOTICS IN ORAL HEALTH

Dental caries is a disease where bacterial process effect damage to the hard structure of tooth, characterized by acid demineralization of the tooth enamel. This leads to the formation of cavities on the surface of the tooth.¹³ It is well-recognized that *Streptococcus mutans* is the most destructive bacterial strain in the mouth as it attaches easily to the teeth and produces acid. A statistically significant reduction of salivary *S. mutans* was recorded in individuals that consumed probiotic yogurt in contrast to control yogurt.¹⁴ Using a randomized controlled trials method, Meurman et al reported that long-term consumption of milk containing the probiotic *Lactobacillus rhamnosus* GG strain reduced initial caries in kindergarten children.¹⁵

Periodontal health: The oral microbiota is at least equally as complex as the gastrointestinal or vaginal microbiota. The current view on the etiology of plaque-related periodontal inflammation considers three factors that determine whether disease will develop in a subject: a susceptible host; the presence of pathogenic species; and the reduction or absence of so-called beneficial bacteria. In 1954, beneficial effects of lactic acid bacteria on inflammatory infections of the oral mucosa was reported.¹⁶ Chronic periodontitis could also benefit from orally administered probiotics. With the help of antagonistic interactions, the presence of periodontal pathogens could be regulated. Probiotic strains included in periodontal dressings at optimal concentration of 10⁸ CFU/ml have been shown to diminish the number of most frequently isolated periodontal pathogens: *Actinomyces* sp, *Bacteroides* sp. and *S. intermedius* and also *C. albicans*.¹⁷

Studies by Mohammad S Al-Zahrani have shown an inverse association between the intake of dairy products and prevalence of periodontitis.¹⁶ Periodontal inflammation has been reduced and also positively affected by the administration of two probiotic tablet forms Bifidumbacterin and Acilact available on the Russian market.¹⁸

Halitosis has many causes (including consumption of particular foods, respiratory tract infections, metabolic disorders), but in mostly it is associated with an imbalance of the commensal microflora of the oral cavity.¹⁹ Halitosis is not a disease but a discomfort, probiotics are marketed for the treatment of both mouth- and gut-associated halitosis. Only a few clinical studies have proved different probiotic strains or products to be efficacious. The studied strains are *E. coli* Nisle 1917, *S. salivarius* K12, three *Weissella* confuse isolates, and a lactic acid-forming bacterial mixture, not specified by the authors of that work.²⁰

For oral cancer: The anticancer effects of probiotics were long recognized but evidence in literature is minimal. It is seen that probiotics can interfere at various stages of cancer process, by interfering with chromosomes and DNA damage. Still, more researchs are required to develop specific regulations on their consumption.¹⁵

Orthodontic treatment: The complex design of orthodontic bands and brackets may create an ecological environment that facilitates the establishment and growth of cariogenic mutans streptococci strains. Cildir et al in 2009 conducted a clinical study with probiotics and found out that daily consumption of fruit yogurt with *Bifidobacterium animalis* subsp. Lactis DN-173010 could reduce the salivary levels of mutans streptococci in orthodontic patients with fixed appliances.¹³

SIDE EFFECTS OF PROBIOTICS

In general, gas and bloating is one of the side effects of eating probiotic supplement.

Probiotic can heighten and stimulate the immune system. So there is a great chance that people with underlying health issues can catch infections caused by probiotics. Till date, no pathogenic or virulence properties have been found for *Lactobacilli*, *Bifidobacterium* or *Lactococci* (Aguirre and Collins 1993). Some *Lactobacilli* strains have been associated with adverse effects, such as rare case of bacteremia.²

CONCLUSION

Probiotics are an emerging area of research in oral health; however, they have been well studied in relationship to systemic/gastrointestinal health. Current findings on the potential use of probiotics against oral conditions are very encouraging. Research is still required in this area, but the use of probiotics to manage the oral microflora is

looking to be a very effective adjunct way to control oral conditions that affect so many people worldwide. Studies are also needed for the identification of probiotics that are ideal for oral consumption as well as the adequate vehicles for their delivery: food products, such as cheese, fermented milk, yogurt or supplements, such as lozenges, chewing gum, etc.

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