OPEN ACCESS
Global Journal of Research in Dental Sciences
Volume 01| Issue 01 | July-Aug | 2021
Journal homepage: https://gjrpublication.com/journals/
Review Article

Role of Probiotics in Oral Health

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Submission Date: 07 Aug. 2021 | **Published Date:** 29 Aug. 2021

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Abstract
Probiotics have been extensively studied in recent times for their health-promoting effects. Probiotics are usually used in the form of foods or food supplements. Probiotic bacteria seem to affect both oral health and immune responses. Probiotics provide an effective alternative way to combat periodontal diseases. In recent times there has been an increase in the incidence of antibiotic resistance, and usage of probiotics could be a promising field of research in the treatment of periodontitis.

Keywords: Bacteria, Immune system, Probiotics, Oral health.

INTRODUCTION:

Bacteria have always been associated with multiple disease conditions in humans including various oral health-related issues like periodontitis, dental caries, etc. However, not all bacterium are unhealthy. The concept of beneficial bacteria has been associated with gut health. The term "probiotic" is relatively a new word and is considered as a term antagonist to "antibiotic". It was introduced by Lilly and Stillwell in 1965 as "Substances produced by micro-organisms which promote the growth of other micro-organisms."

Fuller defined probiotics as "a live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance." According to the FAO/WHO, currently, probiotics are defined as living micro-organisms[1], principally, the bacteria that are safe for human consumption and when ingested in sufficient quantities have a beneficial effect on human health, beyond the basic nutrition."

The construct of probiotics was initial introduced within the decade by Russian scientist and Nobel laureate **Eli Metchnikoff** who showed beneficiary properties of fermented dairy products. In 1894, he showed that cholera could have been prevented by the presence of antagonistic organisms in the intestine[2]. He explained that "probiotics are viable bacteria that beneficially affect the host by improving its intestinal microbial balance."

Mechanism of action of probiotics:

The mechanism of action of probiotics can be divided into three main categories:

- Anti-microbial activity,
- Modulation of the host immune response and
- Competitive inhibition of lethal periodontopathogens.

Anti-microbial activity of probiotics:

Certain metabolites released by probiotic bacteria act as toxic anti-microbial substances such as lactic acid, hydrogen peroxide, bacteriocins and bacteriocin-like inhibitory substances. Firstly, lactic acid being a short-chain fatty acid easily crosses the cell membranes of certain bacteria seen in the oral cavity, especially, Porphyromonas gingivalis,

Streptococcus mutans and Prevotella intermedia and acidifies their cytoplasm, thereby affecting their multiplication. This lactic acid is being produced mainly by obligatory homo-fermentative probiotic, Lactobacillus gasseri is more in healthy individuals compared to periodontitis affected persons. Hydrogen peroxide, produced by probiotic bacteria also has the ability to act against the replication capability of certain pathogenic species of the periodontium. In a study conducted by Hillman & Shivers (1988)[5] in a rat model, they proved that hydrogen peroxide producing S.sanguinis introduced rats had 45- fold low levels of A.actinomycetemcomitans compared to the control group of rats introduced with non-hydrogen peroxide producing strain of S.sanguinis.

Bacteriocins, which are produced by some probiotic bacteria, also exhibit anti-microbial activity. These bacteriocins are nothing but simple peptides produced in the ribosomes. The spectrum of microbial activity for bacteriocin-like substances such as reutrin and reutricyclin is greater than bacteriocins. These bacteriocins are produced by probiotic species like Streptococcus salivarius. Lactobacillus paracasei HL32 produces bacteriocin, which has the ability to change the envelope of P.gingivalis and thereby lethally killing it.

Modulation of host-immune response:

Probiotics also have powerful anti-inflammatory activity by modulation of both innate and acquired immunity of the host. Probiotic bacterial cell wall, their DNA, and their metabolites are recognized by the host as epithelial and immune cells. Lactobacillus species such as Lacobucillus acidophilus and Lactobacillus casei increase phagocytic activity of macrophages and also regulate phagocytic receptors on neutrophils. Probiotics also stimulate dendritic cells (antigen-presenting cells) resulting in T-helper cells 1 or T-helper cells 2. Intracellular pathogens are phagocytosed by TH1 response, while extracellular pathogens are phagocytosed by TH2 response. The activity of matrix metalloproteinase, nitric oxide synthase, prostaglandin E2, and interferon levels are decreased in saliva due to probiotic action.

Competitive inhibition of periodontopathogens:

This activity of probiotics occurs again by two mechanisms, one is inhibition of adhesion of lethal pathogens to the host and the other is inhibition of uptake of nutrients by pathogenic strains of bacteria. Streptococcus species are known to produce certain surfactants that prevent or decrease the attachment of pathogenic species to the pellicle. These species also have the capacity to modify components of pellicle, thereby decreasing the attachment of pathogenic microorganisms. The other mechanism is that probiotic bacteria use the nutrients earlier than pathogenic bacteria and strive them to death. This can be explained in pregnancy, where Prevotella intermedia utilize vitamin-K as its nutrient. Hormones like estrogen and progesterone which are much increased in the sulcular fluid in pregnancy supply these nutrients to P. intermedia and thereby pathogenic microbiota are increased in pregnancy.

The most commonly used probiotic bacterial strains belong to the genera Lactobacillus and Bifidobacterium [4]. Examples of micro-organisms that are considered to be probiotics are Lacidophilus, L.casei, L.crispatus, L.fermentum, L.gasseri, L.johnsonii, L.paraeasei, L.plantarum, L.reuteri, L.rhamnosus, B.bifidum, B.breve, B.infantis, B.longum, B.lactis, B.adolescentis. Others strains include Saccaromyces boulardii, Lactococcus lactis cremoris, Enterococcus faecium, S.salivarius and its sub-species Thermophilus, S.diaacetylactis, S.intermedius.

Formulations of probiotic products:

1. Culture concentrate is added to a beverage or food (such as fruit juice).
2. Inoculated in prebiotic fibers.
3. Inoculants into milk-based food (dairy products such as milk, milk drink, yogurt, cheese, and kefir).
4. Dietary supplements in concentrated and dried packages such as powder, capsule, gelatin tablets.

Administration of probiotics:

Various vehicles used to administer probiotics are:

1. Lozenge.
2. Straw.
3. Tablet.
4. Cheese
5. Rinse solution.
6. Capsule/ liquid.
7. Yogurt drink.

Probiotics and Periodontal disease:

Periodontitis is defined as infectious disease caused by inflammation of supporting tissues resulting in progressive attachment loss or tooth loss or both. Plaque initiated periodontal disease and probiotics have proved to inhibit plaque formation. The mode of action is by lowering the salivary P^H, so that bacteria cannot form plaque. Probiotics produce antioxidants which help in prevention of plaque mineralization by neutralizing free electrons.

Probiotics are ready to break down putrescence odors by fixating on the venomous gases (volatile sulfur compounds) and ever-changing those to gases required for metabolism.

The main pathogenic agents such as P.gingivalis, T.denticola, A.actinomycetemcomitans are related to disease. These bacteria have wide variety of virulence factors which colonize the sub-gingival sites, escape the host defense system and tissue damage. The persistence of host immune response also contributes a determining factor in progression of the disease.

Streptococcus oralis and Streptococcus uberis have been shown to inhibit the growth of pathogens both in vitro and in vivo. The presence of those organisms is Associate in nursing indicator of excellent dental medicine health.

According to the study conducted by Koll-Klais et al [6], L. gasseri and L. fermentum showed higher prevalence among healthy participants than in patients with chronic periodontitis.

Teughels et al [7] have reported that the sub-gingival application of S. sanguis, S. mitis after scaling and root planing have shown to delay re-colonization of periodontal pathogens. Ishikawa et al [8] observed in vivo inhibition of P. gingivalis, P. nigresens by bodily process of L. salivarius in pill kind.

Riccia et al [9], used lozenges that are incorporated with L. brevis to study its anti-inflammatory effects and reported significant improvement not only in gingival and plaque index but also significant reduction in levels of PGE, and MMPs

Hojo et al [10] suggested that bifidobacterium inhibits some black pigmented bacteria by competing for its essential growth factor vitamin-K.

Probiotics and halitosis:

Halitosis or malodour is one of the common problems among world population, and it may be caused by various local and systemic factors. More specifically, it results from the action of anaerobic bacteria that degrade saliva and food proteins to amino-acids, which in turn transform into volatile sulfur compounds like hydrogen sulfide and methaethinol.

Kang et al [11] have reported a definite inhibitory effect on production of volatile sulfur compounds by F.nucleatum, after ingestion of W.cibaria in both in-vivo and in-vitro studies. Matsuoka et al [13] had reported reduction of oral black pigmented bacteria responsible for halitosis by administration of Lactobacillus salivarius T12711.

Probiotics and dental caries:

Dental caries is caused by streptococcus species, with streptococcus mutans being the most common organism. In order to have a beneficial effect on preventing dental caries, probiotics also should reduce the risk of occurrence of streptococcus mutans in the oral cavity [3]. For this activity, probiotic strains have to adhere and interfere with the integrity of pathogenic microorganisms. They also interfere with the nutrients and growth factors leading to a reduction in the levels of S. mutans in oral cavity.

Replacement therapy involves application of S.mutans strain BCS3-L^1, which is a genetically modified effector strain for prevention of dental caries. Recombinant DNA technology is used to delete the gene encoding lactate dehydrogenase in BCS3-L1 making it unable to produce lactic acid. This strain also helps in elevating levels of peptide antibiotic called mutacin 1140, which acts against other strains of S.mutans. This effector strain replaces the wild strain to prevent or arrest caries and also to promote re-mineralization of carious tooth.

Consumption of probiotic stains such as Lactobacilli or bifidobacteria also reduces the incidence of dental caries. Lactobacillus rhamnosus GG and L.reuteri inhibit colonization of streptococcal cariogenic pathogens, and hence reduce the tooth decay, especially in children. Therefore, Lactobacillus rhamnosus GG in milk or processed cheese is associated in reduction of dental caries incidence in children [15].

Safety concerns: Safety concerns and dosage probiotic organisms are classified by FDA as Generally Regarded As Safe (GRAS).

Criteria for an ideal microorganism used as a probiotic:

1. High cell viability, resistant to low P^H and acid.
2. Resistant to process.
3. Should be human origin.
4. Should be non-pathogenic.
5. Ability to persist.
6. Able to interact or send signals to immune cells.
7. Influence local metabolic activity.
8. Adhesion to conceal the flossing agent.

Potential risks associated with probiotics:

Caution should be exercised concerning with the use of probiotics. Some cases of bacteremia and fungemia have been reported with probiotic use in immune-compromised individual. Lactobacillus endocarditis has been reported after dental treatment in a patient taking L.thamnosus [14].

Replacement therapy:

The term replacement therapy (also called bacterio-therapy) is sometimes used interchangeably with probiotics.

But it differs from probiotics in following:

1. Effector strain is not ingested; it is applied directly in site of infection.
2. Involves dramatic and long term change in indigenous bacteria.
3. Colonization of site by effector strain is minimal.
4. Has minimal immunological impact.

But, probiotics are generally used as dietary supplements, rarely dramatic and are able to exert beneficial effect by influencing immune system

CONCLUSION:

There is an increase in the evidence that supports the use of probiotic strains deliver for oral health benefits. Probiotics offer opportunities to manipulate the oral microbiota by either direct microbiological interactions or by immune-modulatory interactions[12]. Although there's a transparent reasoning to be used of probiotics in odontology health, probiotics ought to be considered as a major component of initial therapy which is directed at the maintenance of normal oral flora. However, systematic studies and randomized controlled trials are needed to know the best probiotic strains and the means of their administration to maintain periodontal health.

REFERENCES:

1. Ross RP, Desmond C, Fitzgerald GF, Stanton C (2005). Overcoming the technological hurdles in the development of probiotic foods. J Appl Microbiol, 98(6):1410-7.
2. Reid G, Bruce AW, McGroarty JA, Cheng KJ, Costerton JW (1990, Oct). Is there a role for lactobacilli in prevention of urogenital and intestinal infections? Clin Microbiol Rev, 3(4):335-44.
3. Meurman JH (2005, Jun). Probiotics: do they have a role in oral medicine and dentistry? Eur J Oral Sci, 113(3):188-96
4. Michael T. Madigan, John M. Martinko (2006, July). Brock Biology of Microorganisms: 11th Edition. Upper saddle river, NJ: Pearson Prentice Hall.
5. Hillman JD, Socransky SS, Shivers M (1985). The relationships between streptococcal species and periodontopathic bacteria in human dental plaque. Arch Oral Biol, 30(11- 12):791-5.
6. Köll-Klais P, Mändar R, Leibur E, Marcotte H, Hammarström L, Mikelsaar M (2005, Dec). Oral lactobacilli in chronic periodontitis and periodontal health species composition and antimicrobial activity. Oral Microbiol Immunol, 20(6):354-61.
7. Teughels W, Newman MG, Coucke W, Haffajee AD, Van Der Mei HC, Haake SK, Schepers E, Cassiman JJ, Van Eldere J, van Steenberghe D, Quirynen M (2007, Nov). Guiding periodontal pocket recolonization: a proof of concept. J Dent Res, 86(11):1078-82.
8. Hiroki Ishikawa, Yuji Aiba, Mutsumi Nakanishi, Yoshitami Ok-hashi, Yasuhiro Koga (2003). Suppression of Periodontal Pathogenic Bacteria in the Saliva of Humans by the Administration of Lactobacillus salivarius TI 2711. J Jap Soc Periodontol, 45:105-112.
9. Riccia DN, Bizzini F, Perilli MG, Polimeni A, Trinchieri V, Amicosante G, Cifone MG (2007). Anti-inflammatory effects of Lactobacillus brevis (CD2) on periodontal disease. Oral Dis, 13 (4):376-85.
10. Hojo K, Mizoguchi C Taketomo N, Ohshima T. Gomi K, Arai T, Maeda N (2007, Jan). Distribution of salivary Lactobacillus and Bifidobacterium species in periodontal health and disease. Biosci Biotechnol Biochem, 71(1):152-7.
11. Crispian Scully & John Greenman. Halitosis (breath odor) (2008). Periodontology 2000. Vol.48, 66–75.
12. Meurman JH, Stamatova I (2007, Sep). Probiotics: contributions to oral health. Oral Dis, 13(5):443-51.
13. Maksuoka T,Sugano N,Takigawa S,Takana M, Yoshimura N.Itok. Koga Y (2006). Effect of oral L salivarius T12711 administration on periodontopathic bacteria in subgingival plaque. J Jap Soc Periodontol, 48: 315-324.
14. Rola N. Husni, Steven M. Gordon, John A. Washington and David L (1997, Nov). Longworth. Lactobacillus Bacteremia and Endocarditis: Review of 45 Cases. Clinical Infectious Diseases, 25(5), pp.1048-1055.
15. Rautio, M., Jousimies-Somer, H., Kauma, H., Pietarinen, I., Saxelin, M., Tynkkynen, S., & Koskela, M. (1999). Liver abscess due to a Lactobacillus rhamnosus strain indistinguishable from L. rhamnosus strain GG. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 28(5), 1159-1160.