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Probiotics: A Review of Natural Way of Treating Periodontal Diseases

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Abstract: ***Probiotics, which are defined as live microbesthat confer health benefits to a host when consumed in sufficientquantities, may offer a low–risk, easy–to–use treatmentoption for periodontal diseases.They are a heterogeneous group of nonpathologic bacteria that are functionally defined by their ability to allay inflammation. They have been used to improvegastrointestinal health and their popularity has prompted increased interest for their role inpromotion of oral health also.A few conventional foods containing probiotics are yogurt, fermented and unfermented milk, soy beverages etc. Most often, they come from two groups of bacteria, Lactobacillus or Bifidobacterium. Probiotics have beenextensively studied for their health promoting effects.The present article summarizes the role of probiotics in periodontal health anddisease and its effectiveness in periodontal therapy.***

Keywords: Probiotics, Bifidobacterium, Periodontal diseases, Super infection, Good Health

1. Introduction

The term 'probiotic' is used to name bacteria with beneficial effects for humans and animals. As an antonym of the term 'antibiotics', it was introduced by Lilly & Stillwell (1965)[1] as ''Substances produced by micro-organisms which promote the growth of other micro-organisms.After introduction of antibiotics life expectancy increased. And it greatly improved the quality of human life by decreasing the mortality rate throughout the world. But the major drawback with antibiotics was that besides killing bad bacteria it also kills good bacteria and hence it disturbs the ecosystem of the body, causing devastating effects on the body like superinfection and drug resistance. In the era of advanced technology introduction of probiotics has widen the field of medicine. Probiotic is derived from Latin word "pro"-for and Greek word "biotic"- life.In 1907 the Ukrainian-born biologist and Nobel laureate Elie Metchnikoff realized that consumption of Bulgarian yoghurt (which contains lactic acid bacteria) was good for health. Metchnikoff worked at the Pasteur Institute in Paris and had discovered *Lactobacillus bulgaricus*, a strain he later introduced into commercial production of sour-milk products in France and throughout Europe. The concept of probiotics was thus born[2].

2. Definition of Probiotics

Lilly & Stillwell in 1965 Substances produced by microorganisms that promote the growth of other microorganisms[1].

Parker in 1974 Organisms and substances that contribute to intestinal microbial balance [10]

Fuller in 1989 A live microbial feed supplement that beneficially affects the host animal by improving its intestinal microbial balance[11].

WHO/FAO report in 2001 Live microorganisms that, when administered in adequate amounts, confer a health benefit to the host.

Schrezemeir& de Vrese in 2001 A preparation of, or a product containing, viable, defined microorganisms in sufficient numbers, which alter the microflora (by implantation or colonization) in a compartment of the host and as such exert beneficial health effects in this host[3].

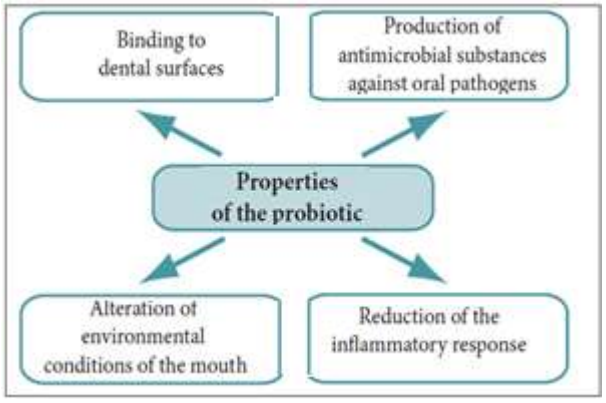
Role of the resident microbiota: More than 700 species of oral microbiota have been detected in the human mouth and the resident microbiota of one individual may consist of 30-100 species[4]. Resident microbiota actively contributes to host protection through;

1) Blocking of colonization by pathogens[5]
2) Development of cell structure and function[6]
3) Development of the immune system and modulation of inflammatory responses[7]
4) Commensal bacteria influence expression of mediators such as intracellular adhesion molecule I (ICAM-I), Eselectin, and Interleukin(IL-8)[8]
5) Commensal bacteria also modulate immune responses and enhance cellular homeostatic mechanisms[9]

Criteria of an ideal microorganism used as probiotics[36]

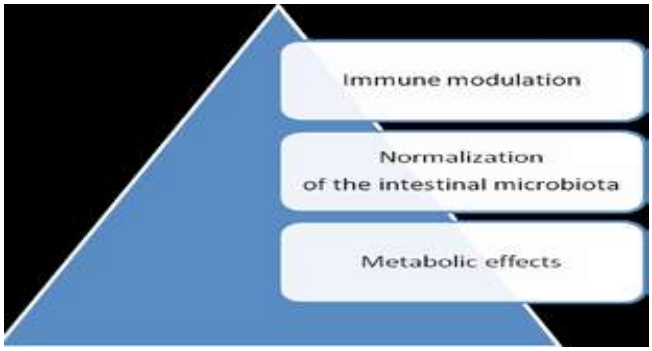
- Ability to persist
- High cell viability, resistant to low pH and acids
- Able to interact or to send signals to immune cells
- Adhesion to cancel the flushing effect
- Should be of human origin
- Resistance to processing
- Influence local metabolic activity

Ideal properties of a probiotic intended for use in disorders of themouth.



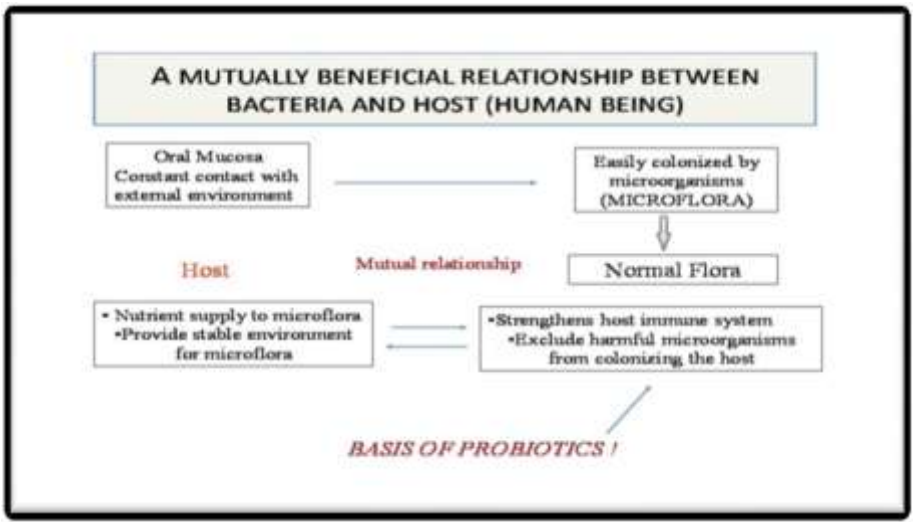
3. Potential Mechanisms Of Probiotic Effects in the Oral Cavity

The general mechanisms of probiotics can be divided into three main categories: normalization of the intestinal microbiota, modulation of the immune response, and metabolic effects.[12]The mechanisms of probiotic action in the oral cavity could be analogous to those described for the intestine. Commensal oral microbes, suggested that some observed probiotic effects are not just properties of a few well-studied strains but common to several species.[13-15]The ecological plaque hypothesis suggests that selective pressure in environmental conditions can change the balance between oral health and disease.[16]

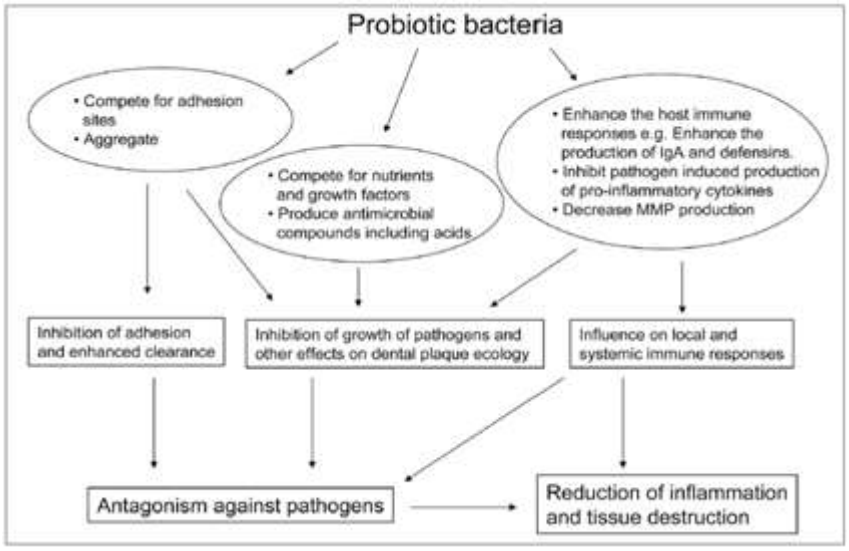


Basis of Probiotics

Mechanism of probiotics



Potential mechanisms by which probiotic bacteria could affect oral health



Replacement Therapy

The term replacement therapy (bacteriotherapy or bacterial interference) has been sometimes used interchangeably with probiotics [17]. This term has been coined by Teughels et al [18]. It refers to the basic idea of replacing pathogenic bacteria by supplying commensalisms, which have same characteristics for oral adherence[19].

Difference between probiotic therapy and replacement therapy[19]

Replacement Therapy	Probiotic Therapy
Effector strain is not ingested and is applied directly on the site of infection by clinician	Probiotics are generally used as dietary supplements .Can be used by individual
Colonization of the site by the effect or strain is essential	Probiotics are able to exert a beneficial effect without permanently colonizing the site
Involves dramatic and long-term change in the indigenous microbiota	Involves transient microbiological change
Directed at displacing or preventing colonization of a pathogen	
Has a minimal immunological impact	Exerts beneficial effects by influencing the immune system

Probiotics in Periodontal Disease

P. gingivalis, A. actinomycetemcomitans, T. forsythia and T. denticola are the main periopathogens of the Socransky"s red and green complex. S. oralis and S. uberis have been reported to inhibit growth of pathogens both in laboratory and animal models. In the absence of these bacteria, tissues become more prone to periodontal disease [20].

Chewing gum "PERIO BALANCE" is the first probiotic gum, specifically formulated to fight periodontal disease. It"s a combination of two strains of L. reuteri specially selected for their synergetic properties in fighting cariogenic bacteria and periodontopathogens. Each dose of lozenge contains at least 2×108 living cells of L. reuteriprodentis. Lozenge has to be used daily after meal or in the evening after brushing teeth, to allow probiotics to spread and adhere to various oral surfaces.

Krasse et al [21] evaluated L. reuteri in a recurrent gingivitis case. A parallel, double blind, randomized, placebo controlled study with 59 patients having moderate to severe gingivitis were selected. L. reuteri strains were administered via chewing gums twice a day for 2 weeks at a concentration of 1×108 CFU along with scaling and root planing. After 2 weeks, the clinical parameters were improved in the group consuming probiotic chewing gums.

Staab B, Eick S, et al[22] observed the reduction of MMP-3, Elastase activity on 50 students with plaque induced gingivitis after having probiotic milk drink for 8 weeks containing L. casei species.

Kang et al[23] in a cross over, open label placebo controlled study including 72 subjects evaluated the efficacy of a probiotic W. cibaria CMS1 rinse. Subjects were instructed to rinse in the morning, afternoon and evening with a 15 ml rinse after brushing. There was a significant reduction in plaque scores in the probiotic rinse group. Hence, W. cibaria isolates possess the ability to inhibit biofilm formation.

Hillman et al[24] carried out a parallel open label placebo controlled study on 24 gnotobiotic rats including a single baseline application and showed significant decreased levels of A. actinomycetemcomitans when compared with placebo group.

Grudianovet al[25] using a mixture of probiotics, reported improvements in clinical signs of gingivitis. Probiotics have also been employed as antimutagenic and anticariogenic agents.

Matsuoka et al [26] did a parallel open label study on 84 subjects consuming L. salivarius T1 2711 tablets 5 times a day for 8 weeks and showed decrease in bleeding on probing and P.gingivlis counts.

Teughelset al[27] conducted a split mouth study on beagle dogs with artificially created pockets. Bacterial pellets of S. sanguis KTH-4, S. salivarius TOVE and S. mitis BMS were applied locally in pockets at 1,2 and 4 weeks. They showed decreased counts of anaerobic bacteria and C. rectus with decreased pocket recolonization and bleeding on probing when compared with controls.

Acilact, a probiotic complex of five live lyophilized lactic acid bacteria, has been claimed to improve both clinical and microbiologic parameters in gingivitis and mild periodontitis patients[28].

Mayanagi et al[29] studied the effect of L. salivarius WB21 tablets on periodontopathic bacteria in a double blind, placebo controlled, randomized clinical trial on 66 healthy subjects. The results showed significant reduction in the sum total of five periodontopathic bacteria: A. actinomycetemcomitans, P. intermedia, P. gingivalis, T. denticola and T. forsythia in the probiotic group compared to the placebo group.

Twetman et al.[30]reported a reduction of clinical symptomscaused by gingivitis after the use of chewing gum containing *Lactobacillusreuteri*for two weeks.

Tsubura S et al.[31]demonstrated that probiotic bacteria accumulated in microbial biofilms thus replacing or reducing pathogenic bacteria.

Ishikawa et al[32]and Matsuoka et al[33] demonstrated that the use of probiotic pills containing *L.salivarius*significantly reduced the concentration of the periopathogenic bacterium *P.gingivalis*in saliva and subgingival plaque in healthy volunteers. Shimauchiet al[34]documented a reduced concentration of periodontopathogenic bacteria after administration of probiotic Lactobacilli over a period of weeks, which was associatedwith improved periodontal conditions[35].

Van Essche et al.[37] have reported that *Bdellovibriobacteriovorus*, attack prey on and kill A.*actinomycetemcomitans*, thus suggesting a potential scope for the role of *B. bacteriovorus*,in the prevention andtreatment of periodontitis.

The inhibitory activity of homofermentive*lactobacilli* against periodontal pathogens was principally related to their production of acid, not hydrogen peroxide or bacteriocin[38]. *Hojoet al*[39]. suggested that *bifidobacterium* inhibit some black pigmented anaerobes by competing for an essential growth factor vitamin K.

Harini PM[40] found that probiotic mouth rinse was effective in reducing plaque accumulation and gingival inflammation.

Astudy done by *Vivekananda MR*[41] using *L. reuteri*Prodentislozenges showed the plaque inhibition, anti-inflammatory, and antimicrobial effects of *L. reuteri*Prodentis. The study proposed that probiotics could serve as a useful adjunct or alternative to periodontal treatment when SRP might be.

Different Means of Probiotic Administration for Oral Health Purposes

Vehicle	Strain	Outcome	Reference
Lozenge	S.Salivarius	Reduce Oral VSC levels	Burton et al (2005)
Straw , tablet	L.Reuteri ATCC 55 730	S.mutans level Reduction	Caglar et al (2006)
Yoghurt	Bifidobacterium DN-173 010	Reduction of Salivary S.mutans	Caglar et al (2005b)
Cheese	L.rhamnosus GG, Prorionibacterium JS	Reduced risk of high yeast counts and hyposalivation	Hatakka et al (2007)
Rinse Solution	W.Cibaria	Reduction Of VSC	Kang et al (2007)
Capsule Liquid	L.sporogenes , L.bifidum ,L.bulgarius L/thermophilus,L.acidophilus, L,casei, L,Rhamnosus	Increased salivary counts of lactobacilli without significant decrease in S.mutans counts.	Montalto et al (2004)
Yogurt Drink	L.Rhamnosuss	Temporary oral cavity colonization.	Yli-Knuuttila et al (2006)

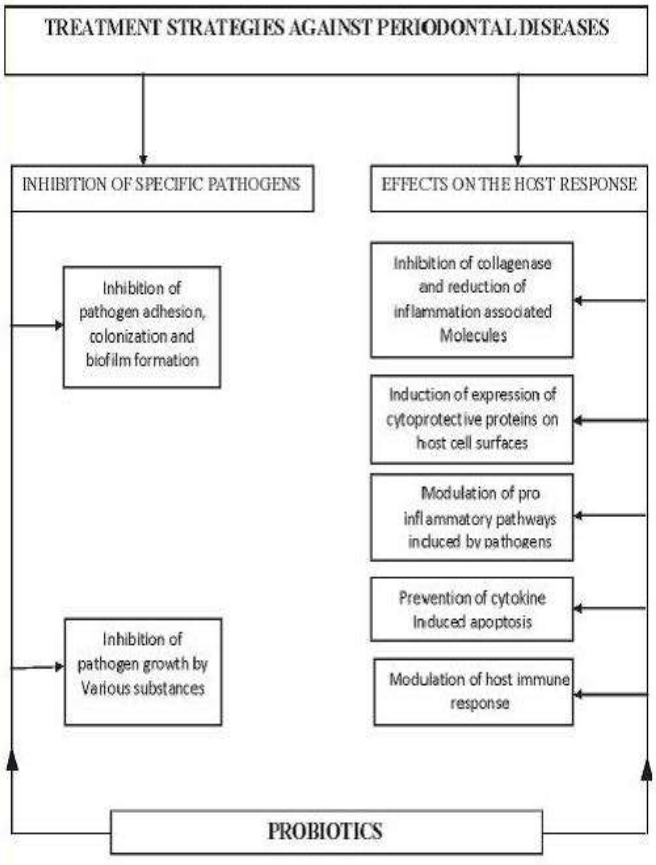
4. Probiotics and Halitosis

Halitosis (bad breath) is believed to affect a large proportion of the population. It has a significant socio-economic impact and may reveal an underlying disease. Halitosis is caused by a number of volatiles, which originate from the oropharynx or from expired alveolar air. In oral malodor, the sulphur containing gases (hydrogen sulfide, methyl mercaptan and dimethyl sulfide), which are derived from the bacterial degradation of sulphur containing amino acids in the oropharynx, play a significant role. A diverse consortium of bacteria has been found to contribute to the problem, including Fusobacteriumnucleatum, R gingivalis, R intermedia and Treponemadenticola. Other gases, such as indole, skatole, putrescine, cadaverine and acetone, are also relevant and sometimes even the dominant cause of halitosis, although their substantively is much lower[42]. Most (85%) of the pathology causing halitosis lies within the oropharynx (tongue coating, gingivitis, periodontitis, tonsillitis).

Kang et al. were the first to use a more scientifically based step-by-step approach in their quest to find a probiotic for the treatment or prevention of halitosis.[43],[2]In children, halitosis has been reduced after gargling with Wcibaria containing rinse. Because of this, there has been a marked reduction in the levels of H28 and CHZSH by approximately 48.2% and 59.4% respectively.[44,45]

Studies carried out to investigate the effect of S. salivarius on oral malodour parameters. The aim was to alleviate halitosis by pre-emptively colonizing the oral cavity with a competitive commensal bacterium following a short course of mechanical and chemical treatment to reduce the numbers of odor-causing organisms and possibly provide additional attachment sites for the colonizing strain. S. salivarius was selected as an oral probiotic because it is an early colonizer of oral surfaces and is amongst the most numerically predominant members of the tongue microbiota of 'healthy' ndividuals. This species also has only a limited ability to produce volatile sulphur compounds and is unlikely to contribute significantly to oral odon S. salivarius has not been implicated either in caries or in other infectious diseases of humans and is most closely related to S. thermophilus, a bacterium which is widely used in the dairy food industry.[46,47,48]

Theoretical possibilities for periodontics to affect periodontal health



5. Future Directions

In field of oral immunology, in the process of enhancing immunity in humans and animals. In oncology field, serious systemic infections may occur during cancer chemotherapy because of disturbances in the oropharyngeal and gastrointestinal microflora, impaired mucosal barrier functions and immunosuppression. Genetically modified probiotic bacteria for pharmaceutical uses. Bacteriophages, viruses that kill bacteria, have been detected in oral pathogens, such as *Actinobacillusactinomycetemcomitans*, 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.

6. Conclusion

There is scientific evidence that specific strains of probiotics microorganisms confer benefits to the health of the host and are safe for human use. Probiotics is a new, interesting field of research in oral microbiology and oral medicine, the examination of the close relationships between oral health and our daily diet. It is a natural way of maintaining health and protecting oral tissues from disease, The research is still in the initial stage. Although the results of past studies are encouraging, still much needs to be done for identification of the probiotics that are best suited to oral use, as well as the most appropriate vehicles for its delivery. Periodontitis has been established as a risk factor for various systemic diseases like diabetes, atherosclerosis, hyperlipidemia, chronic kidney diseases, and spontaneous preterm birth. Thus, a need to establish good periodontal health for attaining good systemic health is of utmost importance and probiotics are promising and safe options, which are required to be explored in depth for periodontal application.

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