International Journal of Research in Engineering, Science and Management
Volume-1, Issue-7, July 2018
www.ijresm.com
ISSN (Online): 2581-5782

Probiotics – A Review

Shweta Patnaik[1], Deepti Gattani[2], Bhagyashri Gudadhe[3]

[1,3]*PG Student, Dept. of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, India*
[2]*HOD & Prof., Dept. of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, India*

***Abstract*: Probiotics are non-pathogenic living micro-organisms which have been added to various foods because of their beneficial effects for human health. There has been a paradigm shift of treatment from specific bacterial elimination to altering bacterial ecology by probiotics. With the increase in the incidence of résistance to antibiotics, probiotics may be a promising area in research in periodontal therapy. They play a beneficial role in preventing common oral health problems such as dental carries, periodontal disease, fungal Infections (Candida) and halitosis. A complete understanding of the broad ecologic changes in the mouth is essential to assess their long term consequences of oral health and disease. The paper reviews the evidence for the use of probiotics and prebiotics for maintenance of oral health and for the prevention of periodontal disease.**

Key Words: Probiotics, Prebiotics, Dental caries, Halitosis, Oral health, periodontal disease.

1. Introduction

Probiotics can be defined as living microbes, or a food ingredient containing living microbes, that beneficially influence the health of the host when used in adequate numbers. The intestine normal micro-flora is metabolically active but as yet unexpected organ of host defence. The large intestine contains 300-500 species of bacteria [1]. Some of these are potential pathogens and cause infection under certain circumstances, and it has been proved that probiotics and prebiotics have an impact or gut flora, and most clinical interest has focused on the prevention or treatment of gastro-interval infections and disease [2]. Probiotics for oral health are not that prolific.

The term probiotics seems innocuous enough. The term may be little misleading because all probiotics are taken by mouth, they have rarely administered via injections, enema or calories. Probiotics almost all functions in the gut, though. The oral probiotics of their article refer to those bacteria that are intended to work in the mouth to alter the oral biofilm to be more healthful. Yes, it is possible to have a more healthful biofilm. The original observation of the positive role played by some selected bacteria was scientifically investigated by Elimetchuikoff, the Ukrainian- born Nobel Prize winner working at the Pasteur Institute at the beginning of the last century. He proposed, in 1907, that the lactic acid producing strain lactobacillus bulgarius (containing in Bulgarian Yogurt) is able displace pathological intestinal micro-biota.

The term "Probiotics" the antonym of the term "antibiotics" was introduced in 1965 by Lilly and Stillwell as substances produced by micro-organisms which promote the growth of other micro-organisms. They showed that several species of protozoa, during their lagaithmic phases of growth, produced substances that prolong the logarithmic phase in other species [3]. The importance of living cells in probiotics was emphasized by Fuller in 1989, who defined probiotics as a "A live microbial feed supplement which beneficially affects the host animals by improving its intestinal microbial balance [4]. The currently used consensus definition of probiotics was put forward by the world health organization and by the Food and Agriculture organizations of the United States.

They defined Probiotics as "Live Micro-organisms" which when administrated in adequate amounts confer a health benefit on the host [4].

A. Characteristics of Probiotics

Probiotics are living microorganisms, principally bacteria that are safe for consumption, which have a beneficial effect in health [5]. To be called a probiotic, a bacterial strain must be fully characterized. The FAO and the WHO have recommended that probiotic bacterial strains are characterized by their spectrum of resistance to antibiotics and haemolytic activities, their capacity to produce toxins, their infectious power in immune compromised animal models and their side effects in humans [6]. These probiotics strains should then be submitted to randomize clinical trials. The result of such studies should demonstrate an improvement of health [7].

B. Composition of Probiotics

Probiotics can be yeast, bacteria or moulds. Most commonly they are bacteria. Some of these bacterial species are:

1. Lactic acid producing bacteria (LAB): Lactobacillus, Bifidobacterium, Streptococcus.
2. Non LAB species: Bacillus, Propionibacterium
3. Non-pathogenic yeasts: Saccharomyces
4. Non spore forming and non-flagellated rod or Coccobacilli

Probiotics have many positive influences in creating better oral health. Probiotics have both direct and indirect interactions. The advantages of direct interactions are many. Basically probiotics help in binding oral microorganisms to proteins & biofilm formation. They fight against plaque formation and on its complex ecosystem by compromising and intervening with bacterial attachments. Through its direct interactions, probiotics compete with oral microorganisms of substances available. This process is the involvement of metabolism of substrate.

Probiotics produce chemicals to inhibit oral harmful bacteria that damage oral hygiene [8]. On the other hand, the indirect interactions of probiotics are effective in the process of removing harmful bacteria and stabilizing normal conditions.

Probiotics modulate and systematize immune function on local community as well as non-immunologic defence mechanisms. Probiotics have the ability to regulate

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ISSN (Online): 2581-5782

permeability and also to develop colonies in oral microflora with less pathogenic species. Probiotics have proved to be effective in curing diseases such as dental caries, periodontal diseases, halitosis and candidiasis [9], [10].

The mechanism of adhesion to oral surfaces is an issue of importance for the long-term probiotic effect of the microorganisms [11]. Among the different assays available to study the adhesion phenomenon, two model systems predominate: systems using saliva-coated hydroxyl apatite, and hydroxyl apatite coated with buffers, proteins and other substances [12].

C. Species

Table-1
Species

Lactic acid producing bacteria	Nonlactic acid producing bacteria	*Bifidobacterium* species	Nonpathogenic Yeast	Non spore forming
Lactobacillusacidophilus	*Enterococcus faecalis*	*Bifidobacterium adolescentis*	*Saccharomyces boulardii*	*Coccobacills*
Lactobacillus bulgaricus	*Enterococcus faecium*	*Bifidobacterium animalis*		
Lactobacillus casei	*Escherichia coli Nissle*	*Bifidobacterium bifidum*		
Lactobacillus crispatus	*Streptococcus thermophiles*	*Bifidobacterium breve*		
Lactobacillus fermentum	*Propionibacterium*	*Bifidobacterium infantis*		
Lactobacillus gasseri	*Bacillus cereus*	*Bifidobacterium lactis*		
Lactobacillus johnsonii		*Bifidobacterium longum*		
Lactobacillus lactis				
Lactobacillus plantarum				
Lactobacillus reuteri				
Lactobacillus rhamnosus GG				

While defined in term as medical probiotics (microbial preparation) and other probiotics (functional food), they are provided in products in one of four basic ways;

1. As a culture concentrate and added to a beverage or food (such as fruit juice).
2. Inoculated into prebiotic fibers.
3. Inoculated into a milk - based food (dairy products such as milk drink, yoghurt, yoghurt drink, cheese, bio- drink).
4. As concentrated and dried cells packaged as dietary supplements.

D. Prebiotics

Prebiotics have been proved to be an aid to complement probiotics in the treatment of oral diseases. Prebiotics are non-digestible dietary supplements. Their function is to enhance the growth and activity of beneficial organisms and simultaneously suppress the growth and activity of potentially deleterious bacteria [13], [14]. In this way prebiotics modify the balance of the intestinal micro-flora. The characteristic feature of prebiotic ingestion is mainly to change microbial population density [15].

Some of the commonly known prebiotics are Lactose, Inulin, Fructo oligosacccharides, Galacto oligosaccharides and Xylo oligosaccharides. Prebiotics are naturally found plenty in certain fruits like bananas, asparagus, garlic, tomato and onion wheat.

The characteristic features of ideal prebiotics are as follows: They are neither to be hydrolysed nor absorbed by mammalian enzymes or tissues. They are selectively enriched with a limited number of beneficial bacteria. The most important characteristic feature is that prebiotics can alter the intestinal micro-flora and its activities. Prebiotics can also change luminal or systemic aspects of the host defence system [16].

E. Ideal Requirements of Probiotic Products

1. Should show the beneficial effect on host animal.
2. Should be non-pathogenic, nontoxic.
3. Should replace and resist the intestinal micro-flora.
4. Should be capable of surviving and metabolizing in the gut environment e.g. Resistant to low pH.
5. Should remain viable under storage for duration.

F. Probiotics and Periodontal Disease

The study on Streptococcus oralis and Streptococcus uberis, beneficial bacteria, has proved to be useful in decreasing the growth of disease causing bacteria. Even the presences of S. oraIis and S. Uberis have proved to be a good indication of healthy gingiva. Grudianov et al found that when compared to mouth wash Tantum Verde; selected strains of L.reuteri have reduced gingivitis& plaque much better and have reduced the counts of S. mutans as well [17]-[20].

All this is with respect to the cases of gingivitis and periodontitis Tablets containing 6.7 X 108 colony forming units (CFU) tablet of L. saIivarius and Xylitol (280mg/tab) significantly decreased the plaque index. This was proved to be effective in the case of smokers [21], [22].

G. Mechanism of Action of Probiotics

Several mechanisms have been proposed regarding action of probiotics. These bacterial strains act by secreting various antimicrobial substances such as, organic acids, hydrogen peroxide and bacteriocines. Furthermore, they compete with pathogenic agents for adhesion sites on mucosa. Probiotics can also modify the surrounding environment by modulating the pH and/or the oxidation reduction potential, which may compromise the ability of pathogen to become established. Finally they provide beneficial effects by stimulating nonspecific immunity and modulating the humoral and cellular immune response.

2. Role of Probiotics in Oral Health

A. Mechanism of Action of Probiotics

The mechanism of action of probiotics in oral health is by direct and indirect mechanisms. Probiotics bring about direct action by:

- Direct interaction on dental plaque,
- Preventing plaque formation by competing and involvement with bacterial attachment on the tooth surface.

Probiotics show indirect action by:

- Modulating the systemic immune system
- Affecting local immunity
- Regulation of mucosal permeability
- Act as antioxidants and prevent plaque formation by neutralizing free electrons [22].

B. Probiotics and Dental Caries

Dental caries is one of the most common oral diseases that need early prevention and intervention. Streptococus mutans is one of main causative organism for dental caries. Elevated levels of streptococcus counts are strongly associated with increased risk of dental caries [10].

Studies have shown that probiotics containg L. rhamnosus GG and L. casei or Bifidobacterium DN-173 010, have

significantly reduced the growth of oral streptococci and dental caries risk [23]. Fermentation of glucose, fructose, mannitol, and trehalose by L. rhamnosus GG resulted in pH values between 5.2 and 6.8 following 24 hours of incubation, thus decreases the decalcification effect of S. mutans.

It has been found that subjects without caries experience are colonized by lactobacilli that possess a significantly increased capacity to suppress the growth of S. mutans. Certain conditions are required to remove cariogenic bacteria from the teeth surface to fight against dental caries. Firstly, probiotic bacteria must be able to stick to the tooth surface where cariogenic bacteria reside. Secondly, they must become a part of the biofilm that develops on teeth. Finally, they must compete with cariogenic bacteria. All this effects of probiotics helps in a drastic reduction of the levels of cariogenic bacterial growth.

C. Periodontal Health

Various oral bacteria are related to periodontal and gingival diseases. The presence of S. oralis and S. uberis often associated with healthy gingiva. Mouth wash using selected strains of L. reuteri or tablets containing 6.7 × 108 colony forming units of L. salivarius and Xylitol (280 mg/tablet) has shown the reduction in gingivitis and plaque accumulation. [5] Studies have shown that 14-day intake of L. reuteri led to the establishment of the strain in the oral cavity and significant reduction of gingivitis and plaque in patients with moderate to severe gingivitis [11]. A L. salivarius WB21 containing tablet when administered to a test group compared with placebo demonstrated insignificant differences in pocket probing depth and bleeding on probing indices. L. casei 37 can reduce the number of most common periodontal pathogens and L. salivarius TI 2711 inhibit P. gingivalis when given for 4 or 8 weeks [12].

D. 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 Fusobacterium nucleatum, R gingivalis, R intermedia and Treponema denticola. 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 [19]. 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 [23, [24]. 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 [25], [26]. 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' individuals. 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 [27]-[28].

E. Probiotics and Candidiasis

Oral cavity with its variety of functions and complex structures is a specific site with its inherent pathology and diseases although the mouth is of course closely related to other parts and systems of the body. Candida albicans is among the most common infectious agents in the oral cavity.

The incidence of yeast infections is higher at older age and under conditions of impaired immunity. Ii takk 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. A decrease in the prevalence of C. albicans in the elderly after consumption of probiotic cheese containing L. rhamnosus GG and ropionibacterium freudenreichii ssp. shermanii IS which was as an interesting observation in this randomized placebo-controlled trial [30].

A concomitant feature of the probiotic activity observed in this study was the diminished risk of hyposalivation and the feeling of dry mouth of the subjects. It could be hypothesized that extending research on oral pathology such as yeast infections, with respect to probiotics, and analyzing the molecular mechanisms of probiotic activity might further broaden the field of their potential applications [21].

3. 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. However considerable work is required to affirm the benefits of probiotics. Probiotics are, nevertheless, a new, interesting field of research in oral microbiology and oral medicine. The research is still in the initial stage.

The idea of probiotics casts new light on the connections between diet and health, including oral health. The complex interplay with respect to the mechanisms of probiotics actions in the development of microbial colonies as well as oral biofilms is yet to be known [32], [33]. Further studies on the

combined effect of different probiotics & prebiotics should be carried out in order to authenticate the possible additive, cumulative, or competitive modes of action in the oral environment. So fan a little has been known about the possible naturally occurring resident probiotics of the mouth. In this regard, it might be interesting to conduct studies on patients with lichen planus, pemphigus vulgaris, cicatricial pemphigoid or apthous stomatitis.

Probably different probiotics are needed for therapy in oral mucosal diseases as there is difference in the microbial attachment sites on the keratinized, and non-keratinized epithelium [13], [34]. In order to assess the best means of administering probiotics, randomized controlled trails are needed. In addition, variation in the dosage for different preventive or therapeutic purposes are also to be studied carefully in order to avoid ill-effects of the species that ferment sugar and lower oral pH that are detrimental to the teeth.

Apart from this, general safety aspects such as those related to potential invasiveness and antibiotic resistance genes must be screened [12], [19]. Probiotics can be used with caution in immunocompromised patients, and contraindicated in premature infants and patients with central venous access in place. Finally, possibilities to genetically modify or engineer potential probiotics strains may offer totally new visions need to studied [13], [19], and [35].

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