

REVIEW ARTICLE***Probiotics: An adjunct to healthy human life***Amit Kumar², K. K. Chaubey¹, Karishma Agarwal², Anudeepika Kashyap²**Abstract**

Probiotics improves the values of human life since the intestinal tract is a diverse microenvironment where more than 500 species of bacteria thrive. A single layer of epithelium is all that separates these microorganisms and pathogens from the underlying immune cells and thus epithelial barrier function is a key component in the defense mechanisms required to prevent infection and inflammation. Probiotics are dietary supplements, which have been advocated for the prevention and the treatment of a wide range of diseases. These products consist of beneficial micro-organisms, which stimulate health promoting flora thus, suppressing the pathologic colonization and disease spread during the last decade an increased interest in alternative, preventive, and therapeutic strategies in dentistry has arisen. Probiotics are living microorganisms which, if administered in sufficient amounts, provide a health benefit to the host. The use of probiotics in prevention and treatment of caries, periodontal diseases, halitosis, and other oral diseases needs to be further investigated.

Keywords: Probiotics, Gastrointestinal tract, Lactobacillus, micro-organisms.

Introduction

Microorganisms have been used for hundreds of years by our ancestors in various food and beverages, and recently have undergone clinical research for their ability to prevent and cure a variety of diseases. In recent years, novel insights have been gained into the role of bacterial micro flora in health and disease.¹

Probiotics are normally bacteria and other microorganisms that have beneficial effects on the human and animal health. According to Fuller², 'a probiotic is a live microbial food supplement that beneficially affects the host animal or humans by improving the intestinal microbial balance'. In the context of the humans it also includes fermented food products, e.g. yoghurt, curd, and lyophilized bacteria etc.

Originally, the term was used to denote microorganisms but now has been extended to refer to viable microorganisms that promote or support a beneficial balance of the autochthonous microbial population of the gastrointestinal tract.

In 1907, the use of a specific class of microorganisms to benefit human health was introduced to the general public by the Nobel Prize winner Elie Metchnikoff.³ In his book "The prolongation of Life", he stated his belief that bacteria in the colon were responsible for adverse health in adults and that consuming sour milk or yoghurt would counteract these harmful bacteria.

He proposed that the strain "Bulgaricus Bacillus", later named *Lactobacillus bulgaricus*, was the strain responsible for conferring better health and longer life in humans.

According to World Health Organization (WHO) and the United Nations Food and Agriculture Organization (FAO) (2002),⁴ "Probiotics are living microorganisms which, when administered in adequate amounts, confer a health benefit for the host".

Probiotics have been found to be beneficial to host health. Due to an increase in antibiotic resistance new treatment methods have been explored. Among them, probiotic approaches are being

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evaluated. Earlier it was thought that 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.

Properties of probiotics

Probiotics have been suggested to have the following properties and functions:-

adherence to host epithelial tissue, acid resistance and bile tolerance, elimination of pathogens or reduction in pathogenic adherence, production of acids, hydrogen peroxide and bacteriocins antagonistic to pathogen growth, safety, nonpathogenic and non-carcinogenic, and improvement of intestinal micro flora (Kaur *et al.*, 2002). It should persist, albeit for short periods in the GI tract influencing metabolic activities such as cholesterol assimilation, lactose activity, and vitamin production.⁵

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 biofilm⁶; and competing with cariogenic bacteria and periodontal pathogens growth⁷.

How do probiotics function in body?⁸

- Inhibit growth or reduce the activity of bad bacteria in intestine by colonizing the gut
- Having antimicrobial activity and aid in increasing our immunity by making our body more resistant to diseases and infections.
- Improve the secretion of digestive enzymes and helps in proper digestion.
- Increase the production of lactic acid and regulates pH balance in intestine and other parts of body.
- Promote acidic pH which facilitates the absorption of protein and minerals like calcium, copper, magnesium, iron and manganese.
- Having anti-inflammatory properties
- It could ferment fructo-oligosaccharides which there by results in reduced pH balance. This

increases acidity in gut thereby enabling better absorption of calcium and allow it to get into blood stream.

Probiotics in health

Probiotics are described as live microbial food ingredients that are beneficial to health of the host, especially by improving intestinal microbial balance. As our population ages, the importance of the prevention of disease has been recognized a new and our entire society has become health-oriented. Following that trend, product development based on beneficial bacteria including lactobacilli is now in full bloom. While there is a scientifically proven benefit to effective probiotics, there is also some confusion amid the wide range of supplements available and the claims made for them. In this review our aim is to extract the potential benefits of probiotics on oral health. Since we have enough to suggest role of probiotics in general health but its efficacy on oral health has not been much explored and more needs to be done in future.

Indications Sanders et al¹¹

Proven indications

1. Rotavirus diarrhea
2. Reduction of antibiotic-associated side effects.

Possible indications

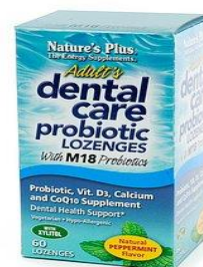
1. Food allergies and lactose intolerance
2. Atopic eczema
3. Prevention of vaginitis
4. Urogenital infections
5. Irritable bowel syndrome
6. Inflammatory bowel syndrome
7. Cystic fibrosis
8. Traveller's diarrhea
9. H. pylori infection
10. Various cancers

Different Probiotic Products available in India
are: ^{10m}Table 2: Different probiotic products

Some Probiotic Products in India	Formulation
Nestle Nesvita	Yoghurt
Yakult	Drink
Amul	Ice cream, Buttermilk
Mothers dairy	BActiv yoghurt, Buttermilk, Nutrifit
Bifilac	Capsules/Sachets
Becelac PB	Capsules/Sachets
Gut pro	Capsules



(c)



(d)



Figure 1: Different products available in India.(a),(b),(c),(d)



(b)

Probiotics and Periodontal diseases

Periodontitis is a multifactorial disease that encompasses the hard and soft tissue, microbial colonization of (with or without invasion), inflammatory responses and adaptive immune responses. Treatment of periodontal diseases in recent years has moved towards an antibiotic/antimicrobial model of disease management. Probiotics might be a promising area of research in the treatment of periodontitis.

Probiotics lower the pH so that plaque bacteria cannot form dental plaque and calculus that causes the periodontal disease¹².

Teughels et al.¹³ reported that the subgingival application of a bacterial mixture including *Streptococcus sanguis*, *S. salivarius*, and *Streptococcus mitis* after scaling and root planing significantly suppressed the re-colonization of *Porphyromona gulae* (canine *P. gingivalis*) and *P. intermedia* in a beagle dog model. This guided pocket recolonization approach may provide a valuable addition or alternative to the

armamentarium of treatment options for periodontitis.

Koll et al¹⁴, characterized 22 strains of orally isolated lactobacilli with regard to antimicrobial activities on oral pathogens including periodontopathic bacteria tolerance to environmental stress in vitro.

Table 1: Summary of the most widely studied types of probiotics⁹

Microorganisms	Strains used as probiotics
<i>Lactobacillus</i> species	<i>L. acidophilus</i> , <i>L. amylovorus</i> , <i>L. brevis</i> , <i>L. casei</i> , <i>L. casei</i> subsp. <i>rhamnosus</i> (<i>Lactobacillus</i> GG), <i>L. caucasicus</i> , <i>L. crispatus</i> , <i>L. delbrueckii</i> subsp. <i>bulgaricus</i> (<i>L. bulgaricus</i>), <i>L. fermentum</i> (<i>L. fermenti</i>), <i>L. gasseri</i> , <i>L. helveticus</i> , <i>L. johnsonii</i> , <i>L. lactis</i> , <i>L. leichmannii</i> , <i>L. paracasei</i> , <i>L. plantarum</i> , <i>L. reuteri</i> , <i>L. rhamnosus</i> .
<i>Bifidobacterium</i> species	<i>B. adolescentis</i> , <i>B. bifidum</i> , <i>B. breve</i> , <i>B. infantis</i> , <i>B. lactis</i> (<i>B. animalis</i>), <i>B. licheniformis</i> , <i>B. longum</i> , <i>B. coagulans</i> .
<i>Streptococcus</i> species	<i>S. oralis</i> KJ3, <i>EvoraPlus</i> , <i>S. uberis</i> KJ2, <i>S. rattus</i> JH145, <i>S. salivarius</i> TOVE-R, <i>S. salivarius</i> K58, <i>S. zooepidemicus</i> , <i>S. oligofermentans</i> .
Other lactic acid bacteria	<i>Enterococcus faecium</i> , <i>Lactococcus lactis</i> , <i>Leuconostoc mesenteroides</i> , <i>Pediococcus acidilactici</i> , <i>Streptococcus thermophilus</i> .
Nonlactic acid bacteria	<i>Bacillus subtilis</i> , <i>Escherichia coli</i> strain nissle, <i>Saccharomyces boulardii</i> , <i>Saccharomyces cerevisiae</i>

Shimazaki et al¹⁵ showed the relationship between the intake of dairy products such as milk, cheese and lactic acid foods (yoghurt and lactic acid drinks) and periodontitis. The results showed that the daily intake of lactic acid foods in subjects with generalized deep probing depth (PD) or severe clinical attachment loss (CAL) as significantly lower than that in subjects with localized deep PD.

Staab and co-workers¹⁶ conducted a study to determine the effect of a probiotic milk drink on gingival health and the development of experimental gingivitis. 50 volunteer students took part and the result showed that in the test group, elastase activity and MMP-3 amount were significantly lower after the intake of the probiotic milk drink. There was a significant increase of MPO (myeloperoxidase) activity in the control group were different at the end of the study. Thus it was finally concluded that probiotic milk has a beneficial effect on gingival inflammation.

Mayanagi et al¹⁷ studied whether the oral administration of lactobacilli could change the bacterial population in supra/sub gingival plaque. Sixty-six healthy volunteers without severe periodontitis were randomized into two groups to receive lactobacilli or placebo for 8 weeks. The result showed that the numerical sum of five selected periodontopathic bacteria in the test group was decreased significantly in sub gingival plaque. Thus concluded that probiotic lactobacilli reduced the numerical sum of five selected periodontopathic bacteria and could contribute to the beneficial effects on periodontal conditions.

Probiotics and oral Candidiasis

Hatakka et al¹⁸ conducted a study that cheese containing probiotic bacteria can reduce the prevalence of oral candida. 276 elderly people consumed daily 50g of either probiotic or control cheese, primary outcome measure was the prevalence of a high salivary yeast count analyzed by the Dentocult method. It was seen that prevalence decreased in the probiotic group from 30% to 21% (32% reduction), and increased in the control group from 28% to 34%. Thus probiotic intervention reduced the risk of high yeast counts by 75%, and the risk of hypo salivation by 56%. It

was concluded that probiotic bacteria can be effective in controlling oral candida and hypo salivation in the elderly.

Hasslof and co-workers¹⁹ conducted a study to investigate the ability of a selection of lactobacilli strains, used in commercially available probiotic products, to inhibit the growth of oral mutans streptococci and *C.albicans* in vitro. It was seen that at concentrations ranging from 10^9 to 10^5 CFU/ml, all lactobacilli strains inhibited the growth of the mutans streptococci completely. The two *L.plantarum* strains and *L. reuteri* ATCC 55730 displayed the strongest inhibition on candida albicans. It was concluded that the selected probiotic strains showed a significant but somewhat varying ability to inhibit growth of oral mutans streptococci and candida albicans in vitro.

Probiotics and dental caries

Dental caries is a multifactorial disease of bacterial origin that is characterized by acid demineralization of the tooth enamel. The advantage of incorporating probiotics into dairy products lies in their capacity to neutralize acidic conditions. It has already been reported that cheese prevents demineralization of the enamel and promotes its remineralization^{20,21}

Petti and colleagues²² reported that yogurt containing *S thermophilus* and *L bulgaricus* had selective bactericidal effects on streptococci of the mutans.

Several clinical studies have demonstrated that regular consumption of yoghurt, milk or cheese containing probiotics led to a decrease in the number of cariogenic streptococci in the saliva and a reduction in dental plaque^{23,24}.

Nikawa and colleagues²⁴ reported that consumption of yoghurt containing *Lactobacillus reuteri* over a period of 2 weeks reduced the concentration of *S. mutans* in the saliva by up to 80%. Comparable results were obtained by incorporating probiotics into chewing gum or lozenges.

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Probiotics and halitosis

Halitosis has many causes (including consumption of particular foods, metabolic disorders, respiratory tract infections), but in most cases it is associated with an imbalance of the commensal microflora of the oral cavity. More specifically, halitosis results from the action of anaerobic bacteria that degrade

salivary and food proteins to generate amino acids, which are in turn transformed into volatile sulphur compounds, including hydrogen sulphide and methanethiol.

Kang and colleagues²⁵ reported the capacity of various strains of *W. cibaria* to inhibit the production of volatile sulphur compounds by *F. nucleatum*. They concluded that this beneficial effect resulted from the production of hydrogen peroxide by *W. cibaria*, which inhibited the proliferation of *F. nucleatum*.

Conclusion

Probiotics have demonstrated an ability to prevent and treat some infections, particularly those confined to the vagina and the gastrointestinal tract. Effective use of probiotics has the potential to decrease patient's exposure to antimicrobials.

Today probiotics are available in a variety of food products and supplements. In the United States, food products containing probiotics are almost exclusively dairy products – fluid milk and yoghurt- due to the historical association of lactic acid bacteria with fermented milk. Probiotics are gaining importance because of the innumerable benefits, e.g. treating lactose intolerance, hyper cholesterol problem, cardiac diseases and managing problems like atherosclerosis and arteriosclerosis. With the current focus on disease prevention and the quest for optimal health at all ages, the probiotics market potential is enormous. Health professionals are in an ideal position to help and guide their clients toward appropriate prophylactic and therapeutic uses of probiotics that deliver the desired beneficial health effects.

Thus probiotics should not be considered a panacea for health, but can be incorporated into a balanced and varied diet to maximize good health.

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