

Review Article

PROBIOTICS AND ORAL HEALTH IN INDIAN SCENARIO- A SYSTEMATIC REVIEW

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ABSTRACT: Diet plays a key role in optimizing oral health and dietary inadequacies have been considered an important aetiological factor in dental disease. Diet as a prevention or treatment option needs to be explored. According to the currently adopted definition by FAO/WHO, probiotics are “living microorganisms, principally bacteria that are safe for human consumption and, when ingested in sufficient quantities, have beneficial effects on human health, beyond the basic nutrition.” Probiotics as dietary supplements are used to treat or prevent a broad range of human diseases, conditions, and syndromes. Traditionally, probiotics have been associated with gastrointestinal tract, however recently several investigators have suggested use of probiotics for oral health. This review elucidates the history of probiotics and focus as on their safety, mechanism of action including its scope for use in the Indian subcontinent.

Key Words: Probiotics, Oral Health, Diet, Lactobacillus Acidophilus, Indian population.

Abbreviations: FAO –Food and Agriculture Organization; WHO-World Health Organization

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INTRODUCTION: Probiotics are commonly defined as viable microorganisms (bacteria or yeasts) that exhibit a beneficial effect on the health of the host when they are ingested. They are used in foods, especially in fermented dairy products such as cheese, yogurt, fermented milk, fruit juice, but also in pharmaceutical preparations such as tablets and capsules¹. The microbes mostly used are Lactobacillus acidophilus or cocci e.g. Streptococcus salivarius, S. Lactis, Entrococcus faecium, and yeast e.g. Saccharomyces cerevisiae, Aspergillus nigere and Candida pintolopesii. Ingestion of probiotics in any form has shown to manage periodontitis, reduce the incidence of dental caries, halitosis and oral candidal infection.

HISTORY: Ellie Metchnikoff was the first to state that probiotics could provide a health benefit, and proposed that Bulgarian people had a longer longevity due to fermented milk containing viable bacteria. The term “probiotic”, as opposed to “antibiotic”, was initially proposed by Lilley and Stillwell in 1965. First probiotic species to be

introduced in research was *Lactobacillus acidophilus* by Hull et al. in 1984 followed by *Bifidobacterium bifidum* by Holcomb et al in 1991.¹

According to the currently adopted definition by FAO/WHO², probiotics are “living microorganisms, principally bacteria that are safe for human consumption and, when ingested in sufficient quantities, have beneficial effects on human health, beyond the basic nutrition. The term “probiotic” is derived from the Latin preposition “pro” which means “for” and the Greek adjective “biotic”, deriving from the noun “bios” which means “life”.

CHARACTERISTICS OF IDEAL PROBIOTICS as cited by WHO² :

1. It should be a strain, which is capable of exerting a beneficial effect on the host, e.g. increased growth or resistance to disease.
2. It should be non-pathogenic and non-toxic.
3. It should be stable and capable of remaining viable for periods under storage and field conditions.

4. It should not have an ability to transfer antibiotic resistance genes.
5. It should be able to maintain genetic stability in intestinal microflora.

MICRO-ORGANISMS USED AS PROBIOTICS

Most probiotics are bacterial species which may include a single bacterial strain or it may be a consortium as well which includes following microorganisms.

A. Bacteria

- i. Lactic acid producing bacteria(LAB):
Lactobacillus acidophilus, Bifidobacterium bifidum, Streptococcus intermedius
- ii. Non lactic acid producing bacteria:
Pediococcus, Propionibacterium, Bacillus

B. Yeast and moulds: *A. cerevisiae*, *A. niger*, *A. oryzae*, *C. Pantolopesii*, *Sacharomyces boulardii*.

Probiotics products are administered in four ways as³:

- 1) A culture concentrate added to a beverage or food (such as a fruit juice, ice creams).
- 2) Inoculated into prebiotic fibres.
- 3) Inoculants into a milk-based food (dairy products such as milk, milk drink, yoghurt).
- 4) As concentrated and dried cells packaged as dietary supplements (non-dairy products as powder, capsule, gelatin tablets or lozenges).

Probiotics have been used as growth promoters, for lactose intolerance, antitumour and anti-cholesterolaeamic effects. Probiotics have been extensively studied under in vitro and in vivo conditions. The main fields of research with respect to probiotics are heart diseases, allergic reaction cancer and diarrhea. However, in the past few years probiotics have also been investigated in the oral health perspective.

USES IN DENTAL CONDITIONS

PERIODONTAL DISEASES^{1, 4,5}

Periodontal diseases are classified into two major types – gingivitis and periodontitis. Gingivitis is characterized by inflammation of gingiva, whereas periodontitis is a progressive, destructive disease that affects all supporting tissues of teeth, including the

alveolar bone. The main pathogenic agents associated with periodontitis are *P. gingivalis*, *Treponema denticola*, *Tannerella forsythia* and *Aggregatibacter actinomycetemcomitans*. The treatment strategies conferred by probiotics against periodontal diseases are mainly anticipated to be either by inhibition of specific pathogens or by altering the host immune response through multifactorial factors. (TABLE 1) For probiotic to be effective in periodontal conditions, routes of administration should be able to provide prolonged contact with oral tissues, facilitating probiotic adhesion to saliva coated surfaces. Thus, lozenge form or chewing gum might better serve the needs for periodontal health prophylaxis.

The probiotic strains which can be used include *L. reuteri strains*, *L. brevis (CD2)*, *L. casei Shirota*, *L. salivarius WB21*, and *Bacillus subtilis*. *L. reuteri* and *L. brevis* have improved gingival health, as measured by decreased gum bleeding. The use of probiotic chewing gum containing *L. reuteri ATCC 55730* and *ATCC PTA 5289* also decreases levels of pro-inflammatory cytokines in GCF, and the use of *L. brevis* decrease SMMP (collagenase) activity and other inflammatory markers in saliva. With *L. casei Shirota* and *Bacillus subtilis* no difference in test and control groups in gingival bleeding or measured plaque index was observed, but the use of *L. casei Shirota* decreased PMN elastase and MMP-3 activities in GCF, and gingival inflammation was lower in the group consuming the probiotic product.

In WHO/CAPP survey on Indian population in 2003, a low prevalence of gingival bleeding in 12 and 15 year olds was reported. In 35-44 years and 65-74 years, higher prevalence of 100% was reported from few of the states (Orissa, Rajasthan). The loss of attachment (3 mm or more) was 77% in 35-44 year age group and 96% in 65-74 years olds in Maharashtra. These statistics indicate that the status of periodontal health in Indian subcontinent is not satisfactory.

Hence to improve oral health, promoting oral health awareness and disease prevention are approaches which should be practiced. In disease prevention, good oral hygiene measures along with dietary modifications are required which, most importantly, includes the uses of probiotics for prevention of dental caries¹³.

MECHANISM OF ACTION OF PROBIOTICS (Table 1)

Table 1: Mechanisms of Action of Probiotic in The Oral Cavity ^{1,4}

Direct interactions in dental plaque	Involvement in binding of oral micro-organisms 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 micro-organisms of substrates available).
Indirect probiotic actions in the oral cavity	Production of chemicals that inhibit oral bacteria (antimicrobial substances)
	Modulating systemic immune function.
	Effect on local immunity.
	Effect on non-immunologic defence mechanisms
	Regulation of mucosal permeability.
	Selection pressure on developing oral microflora towards colonization by less pathogenic species.

DENTAL CARIES ^{5,6,7}

According to WHO/CAPP report on national oral health survey conducted in 2003, the prevalence of dental caries among 12-15 year olds was found to be 45-55 % in states of Delhi, Rajasthan and Uttar Pradesh. Dental caries prevalence in 35-44 year olds was 48% in Orissa ,86% in Delhi and Maharashtra. Among the elderly, in 65-74 yrs age group, the survey reported caries prevalence to be about 51-95% in various states¹³.

To have a beneficial effect in limiting or preventing dental caries, a probiotic must be able to adhere to dental surfaces and integrate into the bacterial communities making up the dental biofilm. It must also compete with and antagonize the cariogenic bacteria and thus prevent their proliferation . Probiotics can reduce the risk for a high *Streptococcus mutans* (*S. mutans*) level occurrence . Çaglar et al⁵, in a comparative study of *S. mutans* reduction effects by several probiotic administration forms, showed a reduced *S. mutans* level in patients receiving fluid or tablet probiotic forms. Nikawa et al. reported that consumption of yoghurt containing *Lactobacillus reuteri* (*L. 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. In a study by Nase et al., they found that children consuming milk containing probiotic, particularly those 3–4 years of age, had significantly fewer dental caries and lower salivary counts of *S. mutans* than controls. These promising

results suggest a potentially beneficial application of probiotics for the prevention of dental caries.

HALITOSIS ⁸

The rationale of probiotic implementation in cases of halitosis has been documented in several studies. *S. salivarius K12* taken in a lozenge after a mouthwash could reduce oral Volatile Sulfur Compound(VSC) levels in 85% of the subjects in the test group. *Weissella cibaria* is another species being able to reduce VSC production both in vitro and in vivo. A contributing factor to malodor reduction can be the ability of *W. cibaria* to co-aggregate with species renowned for their Volatile Sulfur Compound (VSC) production (*F. nucleatum*, for example), thus reducing the source for malodorous compounds in the oral cavity.

CANDIDAL INFECTIONS

Candida species constitute part of the commensal oral flora in about 50% of healthy subjects, but able to cause a clinically apparent lesion if the immune defenses were breached either on the local or systemic level. One study has shown that the subjects who consumed cheese containing the probiotic *L. rhammosus GG* exhibited reduction in the prevalence of oral Candida which subsequently may confer protective effect against oral candidosis. However, others investigated the effect of various lactobacilli and could not find an effect on oral Candida. This may be partly explained by the finding of the ex vivo experiment which demonstrated a profound but variable abilities of commercially

available strain of lactobacilli probiotics to inhibit the growth of *C. albicans* possibly due to the low pH milieu produced by the lactobacilli. Relevant to this is the laboratory study which demonstrated that the *Candida*-infected mice which were fed with *L. acidophilus* exhibited accelerated clearance of *C. albicans* from the mouth.⁹

SAFETY OF PROBIOTIC

As viable probiotic bacteria have to be consumed in large quantities, and over an extended period of time for beneficial effects, safety becomes a primary concern. The traditional use of probiotics particularly lactobacilli in food processing, without significant adverse effects in humans, has long attested to their safety. In recent years, there have been reports of isolated cases of opportunistic infections caused by certain probiotics, such as *Enterococcus* and *saccharomyces* species. *Enterococci* are of particular medical relevance because of their increasing importance as a cause of nosocomial infection, coupled with evolving antimicrobial resistance. The potential for genetic transfer of virulence factors from mechanical strains to culture starter strains via a natural conjugation process has now been demonstrated. Current FAO/ WHO guidelines recommends that probiotics strains should be evaluated for a number of parameters including Antibiotic susceptibility patterns, toxin production, metabolic & hemolytic activities, infectivity in immunocompromised animal models, side effect & adverse incidents in humans^{10,11}.

STATUS OF PROBIOTICS IN INDIA: *Sporolac, saccharomyces boulardii* and yogurt (*L. bulgaricus* + *L. thermophilus*) are the most common ones used. *Sporolac* is manufactured using *sporolactobacilli*. *Lactobacilli* solution is an example of a probiotic, usually given to pediatric patients. the latest and recent addition to the list of probiotics in India is made up of genetically modified *Bacillus mesentericus* which act as an alternate to B-complex capsules.¹²

FUTURE PERSPECTIVES AND CONCLUSIONS

Probiotics are new area of research in relation to orofacial diseases with a view of the close relationships between food and oral health. Preliminary data obtained by various research laboratories have been encouraging, but numerous

randomized clinical studies will be required to clearly establish the potential of probiotics in preventing and treating oral infections. Clinical trials should be undertaken for identification of the probiotics that are best suited to oral use, the most appropriate vehicles: food products (cheese, milk, yogourt) or supplements (chewing gum, lozenges) and dosages for different therapeutic uses specific to the disease. The effects of probiotics in oral health should be critically evaluated with evidence based approach to formulate novel means to modulate host immunity for protection from dental diseases.

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