

Probiotics and its Role in Dental Caries

ABSTRACT : Probiotics are living micro-organisms added to food, which beneficially affect the host by improving its intestinal microbial balance.

Previous studies have suggested that Probiotics may also affect oral ecology by competing with pathogenic microorganisms or by modulating the host immunity response.

Although only a few clinical studies have been conducted, the result to date suggest that probiotics could be useful in preventing oral infections, specially dental caries .

This article summarizes the currently available data on probiotics and their potential effect on dental caries .

The term Probiotic is a relatively new word meaning 'for life'

United Nation's Food and Agricultural Organization (FAO) and the World Health Organization (WHO) defined probiotics as living microorganisms, principally bacteria that are safe for human consumption and when ingested in sufficient quantities, have beneficial effects on human health, beyond basic nutrition.¹ Probiotics – which is “A live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance?” (Suggested by Roy Fuller 1989) can have important role in improvement of oral health of an individual.

One of the most important threats to oral health is dental caries. Dental caries is a multifactorial, infectious, microbial disease of calcified portion of teeth characterised by dissolution of organic substance followed by disintegration of inorganic substances. Tanzer et al [2001] confirms a central role of streptococcus mutans in dental caries.

Dental caries although not a life endangering disease, is extremely troublesome, incapacitating & expensive. It can directly or indirectly be responsible for pain, infection, facial disfigurement, chewing & speech impairment, and loss of esthetics, as well as malnutrition.

So dealing with dental caries should be directed towards custom made preventive protocol & not just endless surgical repair of sign & symptoms of dental caries.

Prevention of dental caries has been attempted with fluoride in different form, but excess body fluoride can

also cause skeletal and dental fluorosis. Conventional prevention of dental caries is also focused on the removal of dental plaque by in discriminate use of antibacterial mouth rinse but it may not be totally effective as it creates open, non-competitive surfaces for pathogens to re-populate the oral cavity. Other professional prevention of dental caries includes application of pit & fissure sealant, on susceptible pits and fissures of tooth, but are costly. So newer preventive option should also be tried for dental caries. Previous studies have suggested that probiotic approach can be effective in selectively inhibiting oral pathogens or modulate the microbial composition of dental plaque there by reduce the incidence of dental caries

Aims & Objective - The aim of the present article is to summarize the available data on probiotic, its historical background, mechanism of action, function and side effects. The various studies conducted, elaborating the merit & demerit of probiotics on dental caries has also been reviewed. The present article can encourage the clinical and day to day use of probiotic containing product for prevention of different oral diseases specially dental caries.

Historical Background of Probiotics : Ancient classical Roman literature mentioned about food fermented with microorganisms which was used as a therapeutic agent.² Pasteur & his associates, Joubert (1877) noted the role of harmless bacteria to treat infection.³ In the beginning of 20th century Elie Metchnikoff reported that Bulgarians lived longer than other populations & supposed that this was due to their consumption of fermented milk products containing viable bacteria.⁴ He proposed in 1907 that the lactic acid producing strain *Lactobacillus bulgaricus* is able to displace pathological intestinal microbiota by useful microbes.⁵

Around that time Henry Tissier, suggested that bifido bacterium could be administered to patients with diarrhoea to help restore a healthy gut flora in healthy children.⁶

Alfred Nissle used one isolate (E. Coli stain Nissle 1907) to treat a 20 year old woman with chronic ulcerative colitis. After 5 weeks of treatment with 200 mg/day of the strain, remission was achieved.⁷

In spite of all these positive effects, spectacular advent of antibiotics, suppressed the researches on bacteriotherapy but development of different resistant bacterial stain again

pushed up the researches on probiotics.

The term probiotic was first introduced by Lily and Stillwell (1965).⁸

The first probiotic bacteria studied were lactic acid bacteria (Fuller, 1991).⁹

Lactobacillae & *Bifidobacterium* are the main probiotics. Other probiotics are *Escherichia*, *Enterococcus*, *Bacillus*, *Saccharomyces*, *Streptococcus* and *Propionibacteria*.

Criteria for Probiotic Bacteria :

1. To be called a probiotic, a bacterial strain must be fully characterized.¹⁰
2. The genes and species of the micro-organism must be identified according to internationally accepted methods.¹¹
3. The FAO & the WHO have recommended that probiotic bacterial strain be characterized by their spectrum of resistance to antibiotics, their metabolic and hemolytic activities, their capacity to produce toxins, their infectious power in immuno-suppressed animal models and their side effects in human.¹

Mechanism of Action of Probiotics : Probiotic bacteria can act through several paths; Reach the intestine alive and transiently colonize the gut, prevent cellular adhesion & invasion of pathogenic bacteria, modify the intestinal environment by a reduction in pH as a result of fermentation products and they interact and modulate the local and systemic inflammatory immune response.⁸

Role of Probiotics : Experiments suggest a range of potentially beneficial medicinal uses for probiotics – managing lactose intolerance, prevention of colon cancer, lowering cholesterol, lowering blood pressure, reduction of allergies,² improving immune function and preventing infections, reducing inflammation, improving mineral absorption, preventing acute diarrhea & crohn's disease.¹²

Other studies have suggested potential applications in the treatment of cardiovascular disease, urogenital infections, oropharyngeal infections & cancers.^{13, 14, 15}

Apart from this, probiotic can play an important role in prevention of dental caries.

ROLE OF PROBIOTICS IN CARIES MANAGEMENT

Clinical studies have indicated that dental caries is one of the major human diseases caused by the oral microbial flora (Marsh 1994)¹⁶. Currently we know that

the host, bacteria and nutrients are required to foment the production of organic acids and the subsequent demineralization activity.¹⁷

To date the number of studies that have been conducted to find the role of probiotic method to treat the caries causing infection by interfering with the oral colonization of cariogenic pathogens, are limited but the results are encouraging.

In the oral cavity, probiotics to have a role in prevention of dental caries, should adhere to dental tissues as a part of the biofilm and compete with the growth of cariogenic bacteria or periodontal pathogen.¹⁸ thus prevent their proliferation. Finally, metabolism of food grade sugars by the probiotic should result in low acid production.

Comelli et.al¹⁸ reported that *Streptococcus thermophilus* & *Lactobacillus lactis* ssp lactis were the only ones with the capacity to integrate into a biofilm present on a hydroxyapatite surface and to interfere with development of the cariogenic species *Streptococcus sobrinus*.

More recently it was demonstrated that isolates of *W. Cibaria* had the capacity to inhibit both in vitro and in vivo, biofilm formation by *S. mutans* and to prevent proliferation of this bacterial strain.¹⁹

During and shortly after birth the epithelial surfaces in the oral cavity become colonized by various species of the indigenous microflora that tend to persist in the mouth and it is possible that they play a role in the competition with other bacteria and prevent the growth of those that may colonize later.^{20, 21} Interestingly Meurman et al²² showed in vitro that a competition between *Lactobacillus rhamnosus* & *Streptococcus sobrinus* occurs.

A. Haukioja et al (2008) through an in vitro study showed that lactobacillus and *Bifidobacterium* strains used in commercial probiotic products may affect the oral ecology by specifically preventing the adherence of streptococcus mutans and by modifying the protein composition of the salivary pellicle.²³

An early installation & colonization of probiotics in the oral environment would be the first step for an anticipated long term effect but there are limited data available to support this event. Permanent installation of probiotics, may be difficult in persons with an already established microflora,²⁴ but transient colonization during the use of probiotic products seems to be common (Montalto et al 2004, Krasse et al 2006, Yliknuuttila et al 2006).²⁵

Some probiotic strains seem to have positive effects by reducing the number of *mutans streptococci* in human saliva (Nase et al, 2001, clung et al, 2004, Nikawa et al, 2004, Caglar et al, 2005, 2006, 2008).²⁵

Hillman et al introduced a non-acid producing *S. mutans* strain that produces bacteriocin active against other *S. mutans* strains into the oral cavity to replace the naturally occurring cariogenic strains (Hillman 2002). This approach is currently awaiting evaluation for its efficacy in humans.²⁶

Another potential probiotic approach for reducing dental caries involves the use of oral streptococci that are able to metabolize arginine or urea to ammonia (Marquis et al 1993). Since such organisms naturally occur in dental plaque, and therefore may not offer safety concerns, they could be used in probiotic approaches.²⁶

Various oral *Streptococci* have mutual antagonistic effects. Implantation of specific oral *Streptococci* or the encouragement of their growth in dental plaque may thus be considered a probiotic approach by encouraging an ecological shift.

Recently *S. oligofermentans*, a bacterium that could be isolated only from caries free humans, was found to metabolize lactic acid into hydrogen peroxide, thus inhibiting the growth of *S. mutans* (Tong et al 2007).²⁶

In spite of all these studies depicting inhibitory role of probiotic on pathogenic micro-organism causing dental caries, few studies revealed that some species of lactobacillus & Bifidobacterium are associated with the progression of dental caries [Steckson 1978 Boyar and Bowden, 1985; Becher et al, 2002, Tas et. al, 2008]^{25, 27}

With a safety first perspective, it is always advisable that open untreated dental cavities should be temporarily filled before prescribing probiotic supplement and where ever possible a dairy based vehicle for probiotic should be used, as it buffers the bacterial acidogenicity .

Side Effects of Probiotics : In general gas & bloating is one of the side effects of eating probiotic supplement.

Probiotic can heighten & stimulate the immune system .So there is a great chance that people with underlying health issues can catch infections caused by probiotics.

Till date no pathogenic or virulence properties have been found for *Lactobacilli*, *Bifidobacterium* or *Lactococci* (Aguirre & Collins 1993)

Some lactobacilli strains have been associated with adverse effects such as rare case of bacterimia (Saxelin et al 1996).²⁸

Conclusion

Preliminary data obtained by various research laboratories have been encouraging, regarding effect of probiotics on dental caries. Probiotics can be tried for prevention of dental caries as it is cheaper, with reduced side effect.

But long span randomized studies are required about the long term clinical effects of probiotic bacteria on oral health of human being before recommending them.

Studies are required to identify the probiotics that are best suited to oral use, as well as the most appropriate vehicles; food products (cheese, milk, and yogurt) or supplements (chewing gum, lozenges).

SHABNAM ZAHIR¹
SURAJIT BOSE²
AND UTPAL ROYCHAUDHURY³

¹ Department of Pedodontics & Preventive Dentistry Guru Nanak Institute of Dental Science & Research, Kolkata-114, E-mail dr.shabnam.zahir@gmail.com

² The Antioxidant Society of India, E mail sur.bose76@gmail.com

³ Professor, Department of Food technology & Biochemical Engineering Jadavpur University, Kolkata 700 032, E-mail utpal31@hotmail.com

Received : 30 March, 2011

Revised : 21 July, 2011

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