Role of probiotics in dental caries

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Abstract:
Dental caries, a multifactorial disease, has always attracted the profession’s interest as the effects of caries last the life time of the individual. Treating and preventing dental caries in children has always been a challenge and use of bacterial to control this microbial infection of the dental tissue has thrown light into the use of probiotics which sustain and balance the oral health of the individual.

Key words: Dental caries, Probiotics, Lactobacillus, Bifidobacterium.

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Introduction
The term probiotics meaning “for life” is derived from Greek language. It was first used by lily and Stillwell in 1965 who described probiotics as “substances secreted by one microorganism which stimulates the growth of another” and thus was contrasted with the term antibiotics. In the year 1989, fuller defined probiotics as “a live microbial food supplements, which beneficially affects the host animal by improving its microbial balance.” Accordingly to currently adopted definition by WHO/Food and agriculture organisation [2002], probiotics are live microorganisms, which when administered in adequate amounts confer a health benefits on the host. 1

1International life science institute Europe suggests a definition according to which probiotics is “a live microbial food ingredient that, when consumed in ample volume, exerts health benefits on the consumer”. The bacterial genera most commonly used in probiotics preparations are Lactobacillus and Bifidobacterium. 4

Probiotics or health beneficial bacteria have recently been introduced in dentistry after years of successful use in prevention and treatment of gastrointestinal infection and disease. Though probiotics is classified as safe by food and drug agencies around the world, caution needs to be exercised for premature infants and medically compromised patients. 2
History

In the early 1900’s, Dr. Metnikoff of Russia found that certain Bulgarians lived longer, disease-free, and pain free lives. He attributed their diet for their healthy longevity. The diet consisted of yogurt, sour dough, bread, and buttermilk. Dr. Metnikoff discovered that these fermented foods contained beneficial bacteria that were able to take rotten putrescence food and digest them to release some by-products which are full of nutrients and which destroyed the foul odour. To prevent the multiplication of these organisms, he proposed a diet containing milk fermented by lactobacilli, which produce large amounts of lactic acid that could increase the lifespan of humans. The concept of probiotics was thus born which opened a new field of bacteriology.1

Properties of probiotics

An ideal probiotic preparation should have the following properties:

- It should be non-toxic and non-pathogenic preparation.1
- It should have a good self life.1
- It should exert beneficial effect on the host.
- It should reinstate and replace the intestinal micro flora.1
- They should be able to interact or to send signals to the immune cells.5
- It should remain viable during storage and use.6
- It should have good sensory properties.6
- It should be capable of surviving and metabolizing the gut.6
- It should bind to the tooth surface.
- It should alters the ecological conditions of the mouth.
- It should produce antimicrobial substances against pathogens.

Mechanism of action of probiotics:

1. Probiotic bacteria compete for nutrients and binding sites in the biofilm, thus preventing the colonisation of cariogenic pathogen.
2. When attached, probiotic bacteria can produce bacteriocins [e.g. hydrogen peroxide and reuterin] that hamper and inhibit growth of a variety of bacteria.
3. Probiotic bacteria stimulate the specific and non-specific immune response through activation of T cells and production of cytokines that mediates the inflammatory response.

Probiotics influence the oral cavity and the caries balance locally through a direct contact with the oral tissue and systemically [indirect] via the gastrointestinal tract. Studies have shown that probiotic bacteria can survive and grow in saliva, attach to the oral biofilm and coaggregate with caries-associated bacteria. However, it is unlikely that a permanent colonization occurs. Therefore, regular consumption of probiotics products is needed to maintain the preventive and therapeutic levels. It is said that the biofilm in infants are immature and hence the intake of probiotic bacteria in early stage of life could leads to a permanent colonization, but there are no studies with dental focus to support this assumption.

Raid. G stated in his study that Probiotic bacterial mechanisms of action include short
chain fatty acid production, competitive exclusion of pathogens, colonization resistance, bile salt metabolism, enzyme activity, and immunologic effects.³

**Probiotics and Dental Caries**

Dental caries is one of the most common infectious diseases in the world. It can be defined as a destruction of tooth by bacterial fermentation of dietary carbohydrates. Some bacteria are said to be more cariogenic than other, for example Streptococcus mutans. S.mutans strain BCS3-1 is a genetically modified effector strain designed for use in replacement therapy to prevent dental caries. Recombinant DNA technology was used to delete the gene encoding lactate dehydrogenase in BCS3-1 making it unable to produce lactic acid. This effector strain was also designed to produce elevated amounts of a novel peptide antibiotic called mutacin 1140 that gives it a strong selective advantage over most other strains of S.mutans.⁴

**Review of the studies involving probiotics for decreasing dental caries**

Nase et al. [2001]. In a seven-month study on kindergarden children received the probiotic L. rhamnosus and the caries risk was subsequently calculated according to clinical and microbiological data [S.mutans level in saliva and plaque]. Results showed lower levels of S.mutans and less dental caries in the probiotic milk-consumining group.¹

Comelli EM et al. [2002] studied 23 diary bacterial strains for the prevention of dental caries and out of which, only two strains, namely Streptococcus thermophilus and Lactococcus lactis, were able to adhere to saliva-coated hydroxyapatite and were further successfully incorporated into a biofilm similar to the dental plaque.¹ Furthermore, they can grow together with five strains of oral bacterial species commonly found in supragingival plaque. In this system, Lactococcus lactis was able to modulate the growth of the oral bacteria, and was particularly able to diminish the colonization of Streptococcus oralis, Veillonelladispar, Actinomycyes naesulundii and Streptococcus sobrinus. L. rhamnosus is one of the most extensively studied probiotics in oral biology, since it does not readily ferment sucrose and is safer for teeth than lactic acid-producing bacteria. L. Rhamnosus was found to inhibit cariogenic S. mutans, but colonization of the oral cavity by L. rhamnosus seems improbable.¹

Petti S (2008) investigated the differences in susceptibility of strains of viridians streptococci.¹ In vitro, yogurt with live bacteria showed selective anti-mutans activity, suggesting that the overall decrease in mutans streptococci in vivo could be due to a bactericidal effect on S. mutants. Yogurt products containing L.reuteri showed a significant growth inhibitory effect against S.mutans while yogurts with lactobacilli other than L.reuteri did not show such inhibition. Moreover, a double-blind, placebo-controlled trial demonstrated that consuming yogurt with L. reuteri significantly reduced the oral carriage of mutants streptococci, compared to the placebo yogurt.⁷

Calgar et al evaluated the effect of xylitol and probiotic chewing gums on salivary mutants streptococci and lactobacilli and concluded that there is a reduction in the levels of salivary mutants streptococci on daily chewing of gums containing probiotic bacteria or xylitol in a significant way.⁸ However, a combination of xylitol gums and probiotic did...
not seem to enhance this effect. Similar study, they noticed a reduction in the levels of salivary mutants on sucking a medical device containing the probiotic lozenge with L. reuteri once daily for 10days. StecksonBlicks et al (2009) reported that daily use of probiotic milk and fluoride decreases the caries in pre-school children. In another study, Singh et al. [2011] showed that probiotic ice-cream could decrease the count of Streptococcus mutants, but its effect on Lactobacilli count has not been significant.

**Anti-caries effect of Probiotics**

1. Improvement of intestinal barrier integrity and up regulation of mucin production
2. Involvement in binding of oral microorganisms to proteins (biofilm formation), action on plaque formation and on its complex ecosystem by competing and intervening with bacteria-to-bacteria attachments
3. Killing or inhibition of growth of pathogens through production of bacteriocins or other products, such as acid or peroxide, which are antagonistic towards pathogenic bacteria. Involvement in binding of oral micro-organisms to proteins (biofilm formation)

**Role of Probiotics in other diseases:**

**Neonatal necrotizing enterocolitis**

NEC is a harmful disease primarily in newborns that is difficult to treat. Probiotics studies were carried out in neonates adding lactobacillus to evaluate the growth of intestinal microorganisms. No differences were found in the colonization pattern between treated and control infants.

**Inflammatory bowel disease**

Inflammatory bowel disease composed of:

1. Ulcerative colitis (UC)
2. Crohndisease (CD)

Both are autoimmune in nature with the resultant inflammation and disease of the GIT.

In CD there is no evidence of data for benefit of using probiotics. The Cochrane review was completed in 2006 for evaluating utility of probiotics in CD. There is no evidence that probiotics were beneficial in maintaining remission in CD.

**Constipation**

It is a very common compliant among the pediatric population. Many studies are carried out to evaluate probiotic therapy in the management of constipation. studies comparing non pharmacologic means of therapy such as fibre probiotics behaviour therapy were evaluated.

**Irritable bowel disease**

IBS are quite common among the pediatric population. Two studies by kim and colleagues evaluation has shown some improvements in bloating, reduced flatulence. Studied by Michel and bausserman evaluated this probiotics in pediatric patients found improvement in abdominal distention.

**Diarrheal illness**

WHO defines diarrhoea as more than three loose watery stools per day. Many causes of
diarrhoea including autoimmune, genetic, malabsorption and antibiotic associated diarrhoea (AAD). There are some data to suggest improvement in the duration of diarrhoea with the use of probiotics. A Cochrane review was completed in 2010 found that probiotics reduced the risk of diarrhoea lasting greater than 4 days 59% and decreased the duration of diarrhoea by 25 hours. The probiotic that as shown major benefit is Lactobacillus GG. The high dose therapy with Lactobacillus rhamnosus and saccharomyces boulardii may be safe and effective in AAD in healthy children.10

**Autism**

It is a neuro developmental disorder and is characterised as one of the pervasive developmental disorders of childhood. Autism spectrum disorder (ASD) has gastrointestinal complaints. The primary focus in treatment is behavioural and educational interventions augmented with medications. Studies have shown that behavioural pattern could be partially reversed with recolonization with Bifidobacterium infantis. ASD is a multifactorial disease process, there is potential for probiotics to play a role in autism therapy.10

**Medicinal values of Probiotics:**

The major areas of their therapeutic clinical action include11

- Prevention of diarrhoea caused by clostridium difficile.
- Prevention of colon cancer.
- Reduces progression of AIDS.
- Enhancement of calcium absorption.
- Regulation of Immunity.
- Compete against harmful microorganisms, preventing colonization of pathogens.
- Reduction of blood cholesterol levels.
- Reduction of liver toxicities.
- Enhancement of vitamin status (B, K).
- Increases the lifetime of voice prosthesis.

**Probiotic species for oral health**

Probiotics can be varied. They can be yeast, bacteria or moulds. But most commonly, bacterial species are predominant. Some of the species are:11

1. Lactic acid producing bacteria (LAB): Lactobacillus, bifidobacterium, streptococcus
2. Non lactic acid producing bacterial species: Bacillus, propionibacterium
3. Non pathogenic yeasts: Saccharomyces
4. Non spore forming and non flagellated rod or coccobacilli

**Probiotic products:**

Probiotics are provided in products in one of the four basic ways:1

- As a culture concentrate added to a beverage or food [such as fruit juice]
- Inoculated into prebiotic fibres [such as Artichokes, onions, legumes]
- Inoculants in a milk-based foods [dairy products, such as milk, milk drinks, yogurt]
- As dietary supplements in concentrated and dried cell packaged [Non-dairy products such as powder, capsule, gelatine tablets]

**Dosage:**

A daily intake of 1 to 2 dl of fluid [e.g. yogurt] with about 108 live bacteria is advocated. The
corresponding recommendation for tablets and capsules is 2 pieces per day.\textsuperscript{12}

**Conclusion:**

Health promoting effects of probiotics is well known, but their influence on the oral health is blemished. But the current finding on the potential use of probiotics against oral conditions are well encouraging. Recent developments in the use of probiotics for dental caries prevention has been a boon in pediatric dentistry.\textemdash it is essential for the paediatric dentists to know about all the preventive measures against dental caries as they are the one who deal with the children and encounter dental caries very frequently. ‘An apple a day keeps doctor away’ the famous quote now in recent years will definitely modify into ‘Probiotics per day keeps doctor away’.
References


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