

PROBIOTIC LACTO BACILLI AND ORAL HEALTH

¹ Venugopal Reddy N ¹ Professor and Head
² Arun Prasad Rao ² Professor
³ Mohan G ³ Reader
⁴ Raja Rajesh Kumar ⁴ Post Graduate Student

¹ Department of Pedodontics, Rajah Muthiah Dental College and Hospital, Annamalai Nagar, Tamil Nadu, India

ABSTRACT

Probiotics may be defined as the 'Live microorganisms which when administered in adequate amounts confer a health benefit on the host'. Probiotics are being utilized to check the growth of caries promoting and periodontal pathogens in the oral cavity. This article describes the application of lactobacilli probiotics in oral health care and pedodontic practice.

KEY WORDS: Probiotics, Oral health, caries, Bacteriotherapy

INTRODUCTION

The **Food and Agriculture Organization (FAO)** and **World Health Organization (WHO)** defines probiotics as 'Live microorganisms which when administered in adequate amounts confer a health benefit on the host' (FAO/WHO, 2001). Probiotics have a long history of human use, and cultured dairy products, for example, are traditionally consumed in several parts of the world.¹ An increasing number of products containing probiotic bacteria are available and used by consumers. The most commonly used strains belong to the genera *Lactobacillus* and *Bifidobacterium*, genera that are commonly found in the oral cavity, including carious lesions. *Lactobacillus* species are found on both rectal and oral mucosa and most of the probiotic products are consumed orally. It is feasible that the consumed probiotic bacteria also attach to oral surfaces.²

History of Probiotics

The original observation of the positive role played by some selected bacteria is attributed to **Elli Metchnikoff (1907)**, the Russian born Nobel Prize winner working at the Pasteur Institute at the beginning of the last century, who suggested that "The dependence of the intestinal microbes on the food makes it possible to adopt measures to modify the flora in our bodies and to replace the harmful microbes by useful microbes".³

At that time **Henry Tissier (1906)**, a French paediatrician, observed that children with diarrhoea had in their stools a low number of bacteria characterized by a peculiar, Y shaped morphology. These "bifid" bacteria

were, on the contrary, abundant in healthy children. He suggested that these bacteria could be administered to patients with diarrhoea to help restore a healthy gut flora. The works of **Metchnikoff** and **Tissier** were the first to make scientific suggestions concerning the probiotic use of bacteria, even if the word "probiotic" was not coined until 1960, to name substances produced by microorganisms which promoted the growth of other microorganisms (**Lilly and Stillwell, 1965**). The term probiotic is a relatively new word meaning "for life" and it is currently used to name bacteria associated with beneficial effects for humans and animals.³

Vehicles

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

- As a culture concentrate added to a beverage or food (such as fruit juice),
- Inoculated into prebiotic fibers,
- Inoculated into a milk-based food (dairy products such as milk, milk drink, yoghurt, yoghurt drink, cheese, kefir, biodrink) and
- As concentrated and dried cells packaged as dietary supplements (non-dairy products such as powder, capsule, gelatin tablets).⁴

Probiotics in Oral Health(Table I)

The different probiotics in oral health are tabulated (Table-I). Of all the bacteria, genus *lactobacilli* are the commonly utilized in oral health.

Table I: Microorganisms used as probiotics in oral health

I.	<i>Lactobacillus acidophilus, sporogenes, rhamnosus, reuteri, fermentum, lactus, brevis, paracasei, gasseri, salivarius, casei</i>
II.	<i>Bifidobacterium: bifidum, Lactis</i>
III.	<i>Streptococcus: lactis, salivarius, thermophilus</i>

LACTOBACILLUS SPECIES

The common probiotic lactobacilli are utilized for prevention of caries and Periodontal diseases and some of the species are described herewith.

Lactobacillus reuteri

L. reuteri is now well-established as one of the most ubiquitous members of the lactic acid producing bacteria. In the late 1980s Dobrogosz and Casas et al, discovered that *L. reuteri* produced a novel broad-spectrum antibiotic substance via the organism's fermentation of glycerol. They named this substance "reuterin". Reuterin, it was found, inhibited the growth of some harmful Gram-negative and Gram-positive bacteria, along with yeasts, fungi, and protozoa. Researchers found that *L. reuteri* could indeed secrete sufficient amounts of reuterin to cause the desired anti-microbial effects while keeping normal gut flora intact.

***L.reuteri* and Caries**

Nikawa et al found that the consumption of yogurt containing *L. reuteri* resulted in a significant growth inhibition of *Streptococcus mutans*. Recently, new research has concluded that daily chewing of the gum containing probiotic bacteria also reduced the levels of salivary mutans streptococci significantly.

***L.reuteri* and Periodontal Disease.**

In a study done by Krasse et al, two strains of *L. reuteri* were trialled (*L.reuteri* ATCC 55730/ *L. reuteri* ATCC PTA 5289) and both strains were shown to have successfully colonised the oral cavity. A 59% reduction in gingivitis levels and a 42% reduction in plaque levels were recorded after 4 weeks of treatment.

Oral Colonisation

For a probiotic to be effective they should adhere to dental tissues as a part of the biofilm (or plaque) and compete with the growth of cariogenic bacteria or periodontal pathogens. The most effective colonization appears to be from *L. reuteri* with 95% colonization after 14 days.⁵

Lactobacillus salivarius

The probiotic tablets contained 6.7x10⁸ colony forming units (CFU)/tablet of *L. Salivarius* WB21 and xylitol (280 mg/tablet) were originally prepared to contribute for the intestinal microbial balance by providing acid tolerant *L. salivarius* WB21. Using these tablets, it was found that when orally administered, they suppressed the growth of *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis* and *Prevotella intermedia*.⁶

Lactobacillus casei

In a parallel-designed non-blinded study, analysis of the fluid between the gingiva and the tooth (gingival crevicular fluid) showed that the probiotic was associated with reductions in elastase activity, enzyme linked to inflammation and matrix metalloproteinase-3 (MMP-3), an enzyme that was responsible for the degradation of extracellular matrix components and known to have increased activity during inflammation.

Lactobacillus brevis

Lactobacillus brevis CD2 (INERSAN) is known to be endowed with unique metabolic properties, which makes it favourable for bacteriotherapy for various conditions. *Lactobacillus brevis* CD2 produces high levels of enzyme Arginine Deiminase which catalyzes the irreversible conversion of arginine to citrulline and ammonia, therefore decreasing the availability of medium arginine and consequently ornithine, the starting material of polyamine biosynthetic pathway. By depleting the arginine, *Lactobacillus brevis* CD2 can prevent the growth of pathogenic microorganisms such as *H.pylori* for gastritis and *P.gingivalis* for periodontitis, which require the presence of arginine for their survival. Also Arginine Deiminase competes with nitric oxide synthase for common substrate, arginine, to down regulate the production of nitric oxide (NO). (Fig.1)

In *in-vitro* experiments, *Lactobacillus brevis* CD2 has also shown to prevent the pH drop caused by *S.mutans* by producing NH₃. Such buffering effect is considered to be a significant advantage when the clinical application is considered for oral diseases.⁷ (Table-II)

PROBIOTICS IN CHILDREN

Bacteriotherapy in the form of probiotic bacteria with an inhibitory effect on oral pathogens is a promising concept, especially in childhood.

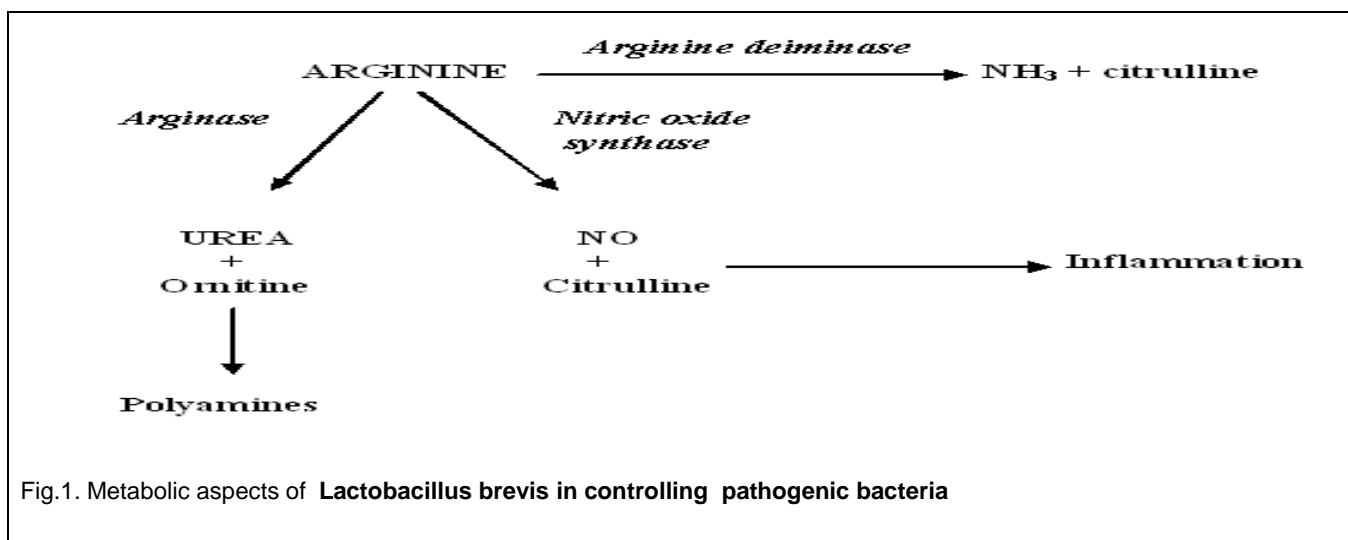


Fig.1. Metabolic aspects of *Lactobacillus brevis* in controlling pathogenic bacteria

A study carried out on preschool children, 1–6 years of age, in Finland, demonstrated that it was possible that a regular intake of probiotic bacteria could prevent dental caries in young children and that the efficiency might vary by age.¹⁴

A study was conducted with *Lactobacillus brevis* CD2 for the treatment of gingivitis in the pediatric patients suffering from marginal gingivitis in 21 subjects. *Lactobacillus brevis* was well tolerated in study subjects and showed no signs of inflammation. A decrease in plaque score, sensitivity and bleeding was observed.⁷

Safety Aspects

A prospective, randomised, double blind and placebo-controlled study was done to evaluate the safety of two probiotic strains in milk in healthy full-term infants. No clinical adverse effects were seen during the trial and the growth, feeding, behaviour and stooling characteristics were similar.¹⁵ A sample group of 24 infants were randomly chosen from the total study population of 232

infants. No symptoms were reported that would normally be associated with acidosis, and there were no safety problems in any of the participating children. The daily supplementation of *L. reuteri* to healthy newborns during their first 12 months was found to be safe.¹⁶

CONCLUSION

Probiotics are, nevertheless, a new and interesting field of research in oral microbiology and oral medicine. The concept casts new light on the connections between diet and health, including oral health. They are probably going to play an important role in combating problems arising from overuse of antibiotics and antimicrobial resistance.⁴ Milk, milk drinks, or yoghurt containing one or more probiotic strains could be a treatment option in the long-term prevention of childhood caries.¹⁷ Some of these technologies may be parenterally administered to treat life-threatening infections and emerging drug-resistant organisms.¹⁸ The influx of studies expected in the coming years, will most likely clarify some of these issues.

Table 2: Summary of clinical studies in adults with lactobacilli-derived probiotics

Authors	Year	Vehicle	Species	Outcome in oral cavity
Ahola et al ⁸	2002	Cheese	<i>Lactobacillus rhamnosus</i>	Decreased counts of yeasts and streptococcus mutans in saliva
Newton biomedical ⁹	2003	Tablet	<i>Lactobacillus paracasei</i>	Inhibits caries causing bacteria and reduces dental plaque
Krasse et al ¹⁰	2006	Chewing gum	<i>Lactobacillus reuteri</i>	Reduction in gingivitis and dental plaque
Caglar et al ¹¹	2006	Straw	<i>Lactobacillus reuteri</i>	Reduction in levels of streptococcus mutans
Della Riccia et al ¹²	2007	Lozenges	<i>Lactobacillus brevis</i>	85% reduction in gingival inflammation
Shimauchi et al ⁶	2008	Tablets	<i>Lactobacillus salivarius</i>	Decreased the plaque index and probing pocket depth
Stephen Daniells ¹³	2009	Milk	<i>Lactobacillus casei</i>	Reduction in elastase activity and gingival inflammation

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Corresponding Author

N.Venugopal Reddy MDS

Professor and Head
Department of Pedodontics & Preventive
Dentistry,
Raja Muthiah Dental College & Hospital,
Annamalai University, Annamalai Nagar,
Chidambaram-608 002. INDIA
Fax: 04144-238080
Email ID: apraprapr@gmail.com