

Review Article

Probiotics for Health and Disease - Myth or Truth????

K Vijay Krishna¹, Shantala Arunkumar^{*2}, Arunkumar J S³ and S V Koti⁴

¹Department of Physiology, Subbath Institute of Medical Sciences, Shimoga. Karnataka State, India

²Department of Oral Medicine and Radiology, SDM college of Dental Sciences and Hospital. Sattur, Dharwad, Karnataka, India

³Department of Otorhinolaryngology and head and neck surgery, SDM College of Medical Sciences & Hospital, Dharwad, Karnataka, India

⁴Department of Ophthalmology, SDM College of Medical Sciences & Hospital, Dharwad, Karnataka, India

*Correspondence Info:

Dr. Shantala Arunkumar

Assistant Professor,

Department of Oral Medicine and Radiology

SDM College of Dental Sciences and Hospital, Sattur, Dharwad. Karnataka, India.

E -mail: drshantalaak@gmail.com

Abstract

Since some decades bacteria known as Probiotics have been supplemented to various foods because of their beneficial effects for human health. The mechanism of action of Probiotics is related to their ability to compete with pathogenic microbes for adhesion sites, to antagonize these pathogens or to modulate the host's immune response. The potential application of Probiotics for excellent health has recently attracted the attention several teams of investigators. Although only a few clinical studies have been conducted so far, the results to date advocate that Probiotics could be valuable supplement in preventing and treating diseases. These article overviews the currently existing data on the potential benefits of Probiotics for overall health and disease.

Keywords: Probiotics, Lactobacillus, Oral health, Live microorganisms

1. Introduction

The concept of Probiotics probably dates back to 1908, when Noble Prize laureate Elie Metchnikoff, Ukrainian born biologist comprehended that the long life of Bulgarian peasants. He attributed their healthy longevity to their diet consisted of yogurt, sour dough, bread and buttermilk. Dr. Metchnikoff discovered that these fermented foods contained friendly beneficial bacteria that were able to take rotten putrescence food and digest them to release by-products that were full of nutrients and which destroyed the foul odor. Metchnikoff worked at the Pasteur Institute in Paris and had discovered *Lactobacillus bulgaricus*, a strain he later introduced into commercial production of sour-milk products in France and throughout Europe. The concept of Probiotics was thus born and a new field of microbiology and was opened.¹

These friendly bacteria that kept the potential pathogens from causing disease were termed Probiotics. The term 'Probiotic', meaning "for life", is derived from the Greek language. It was first used by Lilly and Stillwell in 1965 to describe, "Substances secreted by one microorganism which stimulates the growth of another" and thus was contrasted with the term 'antibiotic'.² According to a WHO/FAO report (2002), Probiotics are 'Live micro-organisms which, when administered in sufficient amount, confer a health benefit on the host'. International Life Science Institute (ILSI) Europe suggests a definition according to which a Probiotic is 'A live microbial food ingredient that, when ingested in sufficient quantities, exerts health benefits on the consumer'.³

To be called a Probiotic, a bacterial strain must be fully characterized. The genus and species of the microorganism must be identified according to internationally accepted methods, and its nomenclature corroborated by reference to the Approved Lists of Bacterial Names. The FAO and the WHO have recommended that Probiotic bacterial strains be characterized by their spectrum of resistance to antibiotics, their metabolic and hemolytic activities, their capacity to produce toxins, their infectious power in immunosuppressed animal models and their side effects in humans.⁴

The first Probiotic species to be introduced in research was *Lactobacillus acidophilus* by Hull *et al.* in 1984, followed by *Bifido bacterium bifidum* by Holcomb *et al.* in 1991. *Lactobacillus rhamnosus* GG, ATCC 53103 (LGG), is the most widely studied Probiotic bacterium. It was originally isolated from human intestine in 1985 and named after the discoverers, Sherwood Gorbach and Barry Goldin. The beneficial effects of LGG on human health were soon documented in many experimental and clinical studies.⁵

However, all Probiotics do not have the same efficacy. It is important that the potential Probiotic strains are well characterized prior to use. A combination of strains can enhance adherence in a synergistic manner.⁵

2. Species and Health Benefits⁶

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

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

3. Mechanism of action of Probiotics in general⁶

The lactobacillus species help in production of enzymes to digest and metabolize proteins and carbohydrates. They aid in synthesis of vitamin B and vitamin K and facilitates breakdown of bile salts. More than 100 species of *L. acidophilus*, *L. brevis*, *L. casei*, *L. rhamnosus*, *L. salivarius* has been identified. They enhance innate and acquired immunity as well as help in inhibition of pro-inflammatory mediators.

Bifido bacterium species are strictly anaerobic and predominate in the large intestines. Over 30 species had been identified. The benefits from these include metabolization of lactose, generate lactic ions from lactic acid and synthesize vitamins. They also ferment indigestible carbohydrates and produce beneficial short chain fatty acids. They are believed to be beneficial in reducing antibiotic associated diarrhea and traveller's diarrhea. They relieve constipation, alleviate inflammatory bowel disease and prevent DNA damage. Finally they may prevent or delay the onset of cancers.

Streptococcus thermophilus and *Lactobacillus bulgaricus* are primary cultures used in yogurt production. Most noted benefits are to metabolize lactose, improve lactose intolerance and antimicrobial activity.

Saccharomyces boulardii is a non colonizing lactic acid producing yeast. It prevents or treats antibiotic- associated diarrhea, *C. difficile* associated disorders, acute diarrhea, traveller's diarrhea in tube fed patients. They are also useful in AIDS related diarrhea and to prevent relapse of Crohn's disease. Most noted feature is that they secrete proteases and other substances that breakdown bacterial enterotoxins and inhibits their binding to intestinal receptors. They also help in immune function enhancement. Most of the beneficial species enhance vitamin production and reduce serum-cholesterol level and in anticarcinogenic activity. Some of the general conditions where Probiotics are proven to be effective are given in table I.

4. Mechanism of action in Oral cavity⁷

It has been stated that oral administration of Probiotics may also benefit oral health by preventing the growth of harmful microbiota or by modulating mucosal immunity in the oral cavity by adhering and colonizing in various surfaces of the oral cavity. These bacteria secrete various antimicrobial substances such as organic acids, hydrogen peroxide and bacteriocins. In addition, they compete with pathogenic agents for adhesion sites on the mucosa. They can also modify the surrounding environment by modulating the pH and/or the oxidation-reduction potential, which may compromise the ability of pathogens to become established.⁴ Although only a few clinical studies have been conducted so far, the results to date suggest that Probiotics could be useful in preventing and treating oral diseases and shown in table II.

Probiotic bacteria have been shown to influence the immune system through several molecular mechanisms.⁸ In oral cavity; possible mechanisms may be by production of antimicrobial substances such as

- ✓ Organic acids
- ✓ Hydrogen peroxide
- ✓ Bacteriocins
- ✓ Binding in the Oral Cavity
- ✓ Compete with pathogens for adhesion sites
- ✓ Involvement in metabolism of substrates (competing with oral micro-organisms for substrates available)
- ✓ Immuno modulatory
- ✓ Stimulate non-specific immunity
- ✓ Modulate humoral and cellular immune response
- ✓ Modifying oral conditions
- ✓ Modulating pH
- ✓ Modification of oxidation reduction potential

5. Why Probiotics for health?

Humans live in close association with vast numbers of micro-organisms present on the skin, in the mouth and in the gastro-intestinal tract (GI tract). The greatest concentration of commensal organisms is found in the GI tract, which has more than 400 m² of surface area. The gut flora is acquired rapidly after birth, remains relatively stable throughout the life and is essential for human homeostasis. When the intestinal microflora is developing, the interactions between this microflora with the host results in evolution of a unique and distinct intestinal immune system.

6. How to select the Probiotics?⁶

The criteria for considering certain product should be:

1. They should be non toxic and non pathogenic preparation.
2. Produce beneficial effect
3. Should withstand gastrointestinal juice
4. Should have good shelf life
5. Should replace and reinstate the intestinal microflora

Table I. Indications for Probiotics for general health¹¹

Proven indications	<ul style="list-style-type: none"> • Rotavirus diarrhoea • Reduction of antibiotic-associated side effects
Possible indications	<ul style="list-style-type: none"> • Food allergies and lactose intolerance • Atopic eczema • Prevention of vaginitis • Urogenital infections • Irritable bowel syndrome • Inflammatory bowel disease • Cystic fibrosis • Traveller's diarrhoea • Enhance oral vaccine administration • H. pylori infection • Various cancers
Others:	<ul style="list-style-type: none"> • Immune enhancement • Hyperlipidemia • Vaccine adjuvant

Table II: Indications of Probiotics for Oral health

<ul style="list-style-type: none"> • Dental caries • Gingival diseases • Periodontal diseases • Candidal infection • Halitosis

7. Method of administration of Probiotics:^{9,10}

Probiotics can currently be administered in the form of sachets or capsules, or can be added to the food supply such as in cheese, Yogurt drink, ice creams etc., For oral disease they can be administered in the form of lozenge, rinse solution, capsule, liquid, Some data show that adequate colonization may be achieved at a lower dose if Probiotics are administered in food.

8. Status of Probiotics in India

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. Only sporulating lactobacilli are used with some of the antibiotic preparations.

9. Safety issues

The issue of safety is of special concern during the past few years due to the increased Probiotic supplementation of different food products This may inevitably leads to higher concentrations of these species in the host organism. *Lactobacillus* bacteremia is a rare entity and its clinical manifestations are extremely inconsistent, ranging from being asymptomatic to septic shock-like symptoms. Any viable microorganism is capable of causing bacteremia, however, especially in patients with severe underlying diseases or in immunocompromised state. Nevertheless, the present literature supports the conclusion that the incidence of *Lactobacillus* bacteremia is unsubstantial and that all the cases where it has been registered are persons with other systemic diseases such as diabetes, cardiovascular diseases, gastrointestinal disorders, malignancies, or organ transplant patients. However, it is apparent that careful supervising is needed in this regard in the future.^{10,11}

10. Conclusion

The statistical data from several current studies suggest the impending broad range beneficial effects of Probiotics. Potential future uses of Probiotics include inflammatory disease control, the treatment and prevention of allergies and infections, cancer prevention, immune stimulation, a reduction in respiratory disease and several oral diseases. Such effects could validate the addition of not single but potentially several Probiotics to usually consumed foods, which could achieve population-wide health benefits.

References

1. Sheikh S, Pallagatti S, Kalucha A, Kaur H. Probiotics. Going on the natural way. *J Clin Exp Dent*. 2011; 3(2):e150-4.
2. Lilly DM, Stillwell RH. Probiotics. Growth promoting factors produced by microorganisms. *Science* 1965; 147:747-748.
3. De Vrese M, Schrezenmeir J. Probiotics, prebiotics, and synbiotics. *Adv Biochem Eng Biotechnol* 2008; 111:1-66.
4. Bonifait L, Chandad F, Grenier D. Probiotics for Oral Health: Myth or Reality? *JCDA*. October 2009; 75(8).
5. Meurman JH. Probiotics: do they have a role in oral medicine and dentistry? *Eur J Oral Sci* 2005; 113: 188–196.
6. Saraf K, Shashikanth MC, Priya T, Sultana N, CSK Chaitanya N. Probiotics - Do they have a Role in Medicine and Dentistry? – A Review Article. *JAPI*; Aug 2010 (58).
7. Bosch M, Molina JN, Audivert S, Bonachera M N, Alemany AS, Fuentes MC, Cune J. Isolation and characterization of probiotic strains for improving oral health. *Archives of oral biology* 2011.
8. Bhardwaj A, Bhardwaj SV. Role of Probiotics in Dental Caries and Periodontal Disease. *Arch Clin Exp Surg* 2012; 1(1); 45-49.
9. Reddy p, srivastava r. Probiotics the next savior in oral diseases- a review. *International journal of dental clinics* 2011;3(2):54-57.
10. Agarwal E, et al. Probiotics: a novel step towards oral health. *AOSR* 2011; 1(2):108-115.
11. Anuradha S, Rajeshwari K. Probiotics in health and disease. *JACM* 2005; 6(1): 67-72
12. Cannon JP, Lee TA, Bolanos JT, Danzinger LH. Pathogenic relevance of *Lactobacillus*: a retrospective review of over 200 cases. *Eur J Clin Microbiol Infect Dis*. 2005; 24:31–40.