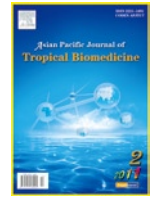


Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

Asian Pacific Journal of Tropical Biomedicine

journal homepage: www.elsevier.com/locate/apjtb

Document heading

Probiotics: A review

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ARTICLE INFO

Article history:

Received 15 July 2011

Received in revised form 27 August 2011

Accepted 23 September 2011

Available online 15 October 2011

Keywords:

Probiotics

Oral cavity

General effects

ABSTRACT

The field of probiotics is an evolving field. Probiotics were first introduced to the world as a functional ingredient in dairy products, breakfast cereals and snacks. Unknown to many, probiotics offer health benefits that go beyond the scope of supporting digestive health. Research continues to emerge, supporting the use of different probiotic strains in a variety of conditions. The research now suggests that these “healthy” bacteria have beneficial effects on gastrointestinal dysfunctions, including diarrhea, as well as the immune system and conditions such as allergy, in children, adults, and in the oral cavity. Research on the horizon will develop a better understanding of the concepts of how colonizing microbes and probiotics can influence human health.

1. Introduction

Golden era of antibiotics began nearly in 1928, when Alexander Fleming, a bacteriologist at London’s St. Mary’s Hospital, found that a mould on a discarded culture plate had an antibacterial action, and the mould was ‘penicillin’.

Introduction of antibiotic revolutionized the field of medicines. After introduction of antibiotics life expectancy increased. And it greatly improved the quality of human life by decreasing the mortality rate throughout the world. But the major drawback with antibiotics was that besides killing bad bacteria it also kills good bacteria and hence it disturbs the ecosystem of the body, causing devastating effects on the body like superinfection and drug resistance. In the era of advanced technology introduction of probiotics has widen the field of medicine further.

“Probiotic,” means that mechanisms are employed to selectively remove only the pathogen while leaving the remainder of the oral ecosystem intact.

Probiotic is derived from Latin word “pro” –for and Greek

word “biotic” – life.

2. Definition of probiotics

Probiotics were defined in 2001 by a group convened by FAO/ WHO Expert Consultation as live microorganisms, which confer a health benefit on the host when administered in adequate amounts. Lactobacillus and bifidobacterium are the most common types of microbes used as probiotics including certain yeast and bacilli^[1]. They are consumed as fermented food with added active live culture *e.g.* yogurt and other dietary supplements.

3. History

Nobel laureate Élie Metchnikoff professor at the paster institute in Paris, in the beginning of the 20th century hypothesized that the reason for the apparent longevity of Bulgarian peasants was that they consumed large quantities of fermented milk products like curd and buttermilk. He believed that the lactic acid bacteria in these products replaced the harmful organisms found in the intestines and thus reduced the production of toxins that lead to disease

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and infection^[2].

4. Composition

Probiotics can be bacteria, moulds, and yeast. But most probiotics are bacteria. Among bacteria, lactic acid bacteria are more popular^[3] in the listed organisms as species used in probiotic preparation. *Lactobacillus bulgaricus* (*L. bulgaricus*), *Lactobacillus plantarum*, *Streptococcus thermophilus* (*S. thermophilus*), *Enterococcus faecium*, *Enterococcus faecalis*, *Bifidobacterium* species, and *Escherichia coli* were listed.

5. Characteristics of ideal probiotics

Fuller^[3] in 1989 listed the following as features of a good probiotic. 1) It should be a strain, which is capable of exerting a beneficial effect on the host animal, e.g. increased growth or resistance to disease. 2) It should be non-pathogenic and non-toxic. 3) It should be present as viable cells, preferably in large numbers. 4) It should be capable of surviving and metabolizing in the gut environment e.g. resistance to low pH, organic acids and bile. 5) It should be stable under storage and field conditions.

And microorganism has to be microbiologically characterized and subjected to randomized clinical trials. Principally it has to be of human origin, scientifically demonstrating beneficial physiological effects and proving being safe for human use. In addition, it has to be effectively able to adhere to the target tissue^[4].

6. Foods containing probiotics and its uses

Foods such as cheese, yogurt, sour cream, smoothies, cereal, fitness bars, infant formulas, asparagus, soybeans contain probiotics. Probiotics are used in general health, animal agriculture, fertility of soil and oral cavity.

7. In general health: nutritional effects

A lactic acid bacterium has been shown to increase folic acid content of yogurt, buttermilk and kefir and to increase niacin and riboflavin levels in yogurt, vitamin B12 and vitamin B6 in cheese^[5]. In addition to nutrient synthesis, probiotics may improve the digestibility of some dietary nutrients such as protein and fat^[6]. Probiotics can be combined with enzymes that help break down food substances into simpler forms to enhance nutrient digestion.

Short-chain fatty acids such as lactic acid, propionic acid

and butyric acid produced by lactic acid bacteria may help maintain an appropriate pH and protect against pathological changes in the colonic mucosa. Synthesized nutrients including folic acid, niacin, riboflavin, vitamins B6 & B12 can increase nutrient bioavailability.

8. Probiotics and calcium absorption

Milk is considered to be abundant with calcium apart from other dietary sources. Individuals with lactose intolerance may probably develop osteoporosis due to decreased consumption of milk containing diet. Calcium absorption is favored in acidic PH. So if probiotics are fed to lactose intolerance patients, then milk lactose is hydrolyzed by probiotic strains, favoring calcium absorption^[7].

9. Lactose intolerance

Few strains of lactic acid bacteria, such as *S. thermophilus*, *L. bulgaricus* and other lactobacilli in fermented milk products, can alleviate symptoms of lactose intolerance by providing bacterial lactase to the intestine and stomach. Because lactose intolerance affects almost 70% of the population worldwide, consumption of these products may be a good way to incorporate dairy products and their accompanying nutrients into the diets of lactose intolerant individuals.

10. Allergy

Probiotics may exert a beneficial effect on allergic reaction by improving mucosal barrier function. In addition, probiotic consumption by young children may beneficially affect immune system development. Probiotics such as *Lactobacillus GG* may be helpful in alleviating some of the symptoms of food allergies such as those associated with milk protein^[8]. Probiotic consumption may thus be a means for primary prevention of allergy in susceptible individuals.

11. Intestinal tract health

A number of studies have found probiotic consumption to be useful in the treatment of many types of diarrhea, including antibiotic-associated diarrhea in adults, travellers' diarrhea, and diarrheal diseases in young children caused by rotaviruses^[9]. The most commonly studied probiotic species in these studies have been *Lactobacillus GG*, *Lactobacillus casei*, *Bifidobacterium bifidum* and *S. thermophilus*. Because diarrhea is a major cause of infant

death worldwide and can be incapacitating in adults, the widespread use of probiotics could be an important, non-invasive means to prevent and treat these diseases, particularly in developing countries. Probiotic bacteria have also been shown to preserve intestinal integrity and mediate the effects of inflammatory bowel diseases, irritable bowel syndrome, colitis, and alcoholic liver disease^[8]. The intestinal effects of probiotics are to relieve effects, promote recovery from diarrhea (rotavirus, travelers' and antibiotic-induced), produce lactase, alleviate symptoms of lactose intolerance and malabsorption, relieve constipation, treat colitis, and stimulate gastrointestinal immunity^[10].

12. Immune system

Evidence from *in vitro* systems, animal models and humans suggests that probiotics can enhance both the specific and nonspecific immune response, possibly by activating macrophages, increasing levels of cytokines, increasing natural killer cell activity, and/or increasing levels of immunoglobulins^[11]. In spite of limited testing in humans, these results may be particularly important to the elderly, who could benefit from an enhanced immune response. The immune system effects of probiotics are to enhance specific and nonspecific immune response, inhibit pathogen growth and translocation, and reduce chance of infection from common pathogens (*Salmonella*, *Shigella*).

13. Cancer

Animal and *in vitro* studies indicate that probiotic bacteria may reduce colon cancer risk by reducing the incidence and number of tumors. One clinical study showed an increased recurrence-free period in subjects with bladder cancer^[12]. Results, however, are too preliminary to develop specific recommendations on probiotic consumption for preventing cancer in humans.

14. Anti-hypertension

Some preliminary evidence suggests that food products derived from probiotics bacteria could possibly contribute to blood pressure control^[13]. This antihypertensive effect has been documented with studies in spontaneous hypertensive rats^[14]. Two tripeptides, valine-proline-proline and isoleucine-proline-proline, isolated from fermentation of a milk-based medium by *Saccharomyces cerevisiae* and *Lactobacillus helveticus* have been identified as the active components. These tripeptides function as angiotensin-converting enzyme inhibitors and reduce blood pressure.

14. Other health effects of probiotics

Probiotics can also be used to reduce risk of certain cancers (colon, bladder), detoxify carcinogens, suppress tumors, lower serum cholesterol concentrations, reduce blood pressure in hypertensives, treat food allergies, improve urogenital health, and optimize effects of vaccines (e.g. rotavirus vaccine, typhoid fever vaccine).

15. Fertility of soil

Probiotics have been used in agriculture to restore fertility to the soil. Probiotics have been used in wastewater systems to eliminate the odor. Probiotics have been used in the animal and poultry industry to prevent disease foods.

16. Probiotics in veterinary practice

They are marketed as either pastes or powders and are commonly given to young foals, horses being trailered or in competition. These products are commonly defined as live microbial feed supplements^[15].

17. Probiotics and oral health

17.1. *Candida* infection

Probiotics are used to control *Candida* infection in elderly patient since elderly are more prone to candida infection provoked by chronic diseases, medications, poor oral hygiene, reduced salivary flow and impaired immune response. Bacteria like *Lactococcus lactis*, *Lactobacillus helveticus*, *Lactobacillus rhamnosus* GG (ATCC53103), *Lactobacillus rhamnosus* LC705 when used in one of the study, showed significant reduction of candida infection^[16].

17.2. Hypo-salivation and feeling of dry mouth

Evidence suggests that probiotics can also reduce the risk of hypo-salivation and feeling of dry mouth^[16].

17.3. Dental decay

It should also be noted that as most probiotics are in dairy forms containing high calcium, possibly reducing demineralization of teeth. Probiotics should adhere to dental tissues to establish a cariostatic effect and thus should be a part of the bio-film to fight the cariogenic bacteria.

17.4. Periodontal infection

Probiotics for periodontal therapy have not been extensively studied. Clinical studies where probiotic species have been investigated specifically from a periodontal disease perspective are sparse. *Lactobacillus reuteri* and *Lactobacillus brevis* are among the species able to affect gingivitis and periodontitis^[17]. According to Koll–Klais *et al*^[18], high levels of *Lactobacillus* in microbiota caused an 82% and 65% inhibition in *Porphyromonas gingivalis* and *Prevotella intermedia* growth, respectively. In one recent study published in 2005, the prevalence of lactobacilli, particularly *Lactobacillus gasseri* and *Lactobacillus fermentum*, in the oral cavity was greater among healthy participants than among patients with chronic periodontitis^[18].

17.5. Probiotics and halitosis^[19]

Regular use of probiotics can help to control halitosis. After taking *Weissella cibaria*, reduced levels of volatile sulfide components produced by *Fusobacterium nucleatum* were observed by Kang *et al*^[20]. The effect could be due to hydrogen peroxide production by *Weissella cibaria*, causing *Fusobacterium nucleatum* inhibition.

In conclusion, probiotics are emerging as a fascinating field in oral medicine. This concept prompts a new horizon on the relationship between diet and oral health. Clinical trails should be directed to assess the method of probiotic administration in oral cavity and dosages for different therapeutic uses. Research should be directed towards the action of probiotics on oral cavity and also on its pathological conditions.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgements

We are thankful to the Narsinhbhai Patel Dental College and Hospital, Visnagar, India and Raval Khushbu and Shah Utsav.

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