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REVIEW ARTICLE

ROLE OF LACTIC ACID BACTERIA AS PROBIOTIC: A REVIEW

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ABSTRACT

Lactic acid bacteria are industrially important organisms recognized for their fermentative ability as well as their health and nutritional benefits.There is an increasing interest in these species to reveal the many possible health benefits associated with them. The actions of LAB are species and strain specific, and depend on the amount of bacteria available in the gastrointestinal tract. However, products with or processed with LAB are accepted as a natural way to preserve food and promote health. This paper aimed to review the recent data in regard to the role of probiotic LAB in food industries, in the immunomodulation in the gastrointestinal tract, and there application in its health benefits.

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INTRODUCTION

Lactic acid bacteria (LAB) are characterized as Gram-positive cocci or rods, non-aerobic but aerotolerant, able to ferment carbohydrates for energy and lactic acid production. The metabolic pathway from glucose may be homofermentative or heterofermentative. In the first case two molecules of lactate are generated (as in *Streptococcus* and *Lactococcus),* and in the second, lactate, ethanol and carbon dioxide as in *Leuconosto*. Lactic acid bacteria are also able to produce small organic substances that contribute with aroma and give specific organoleptic attributes to the products (Caplice and Fitzgerald *et al*., 1999). The microorganisms are found in milk, meat and fermented products, as well as in fermented vegetables and beverages inhibiting the growth of pathogenic and deteriorating microorganisms, maintaining the nutritive quality and improving the shelf life of foods. They have also been used as flavor and texture producers. Lactic acid bacteria include various major genera: *Lactobacillus, Lactococcus, Corynebacterium, Enterococcus, Lactosphaera, Leuconostoc*, *Melissococcus, Oenococcus*, *Pediococcus, Streptococcus, Tetragenococcus, Vagococcus* and *Weissella*. Other genera are: *Aerococcus, Microbacterium*, *Propionibacterium* and *Bifidobacterium* (Carr *et al*., 2002) are some of the most common species (Garrity, 1984., Dellaglio *et al*., 1994), and some strains are recognized as probiotics (Fuller, 1989., Parada *et al*., 2003). Sugar fermentation followed by a reduction in pH due to the production of lactic and other organic acids is an important factor for the inhibition of growth of undesired microorganisms. The low pH makes organic acids liposoluble, them to break through the cell membrane and reach the cytoplasm of pathogens (Haller *et al*., 2001). The competition for essential nutrients, accumulation of D-amino-acids and diminution of the oxiredutive potential also contribute to their inhibitory effect. LAB are usually known as safe (GRAS), and have an important role in the preservation of foods and fermented products. They can be used as natural competitive microbiota or as specific starter cultures under controlled conditions (Cintas *et al*., 2001). Some of these bacteria produce antagonistic substances, called bacteriocins, which in small amounts are very active against pathogens (Klaenhammer *et al*., 1994; Moreno *et al*., 2006) Lactic acid bacteria (LAB) occur naturally in several raw materials like milk, meat and flour used to produce foods (Rodriguez *et al*., 2000). LAB are used as natural or selected starters in food fermentations in which they perform acidification due to production of lactic and acetic acids flavour. Protection of food from spoilage and pathogenic microorganisms by LAB is through producing organic acids, hydrogen peroxide, diacethyl (Messens and De Vugst., 2002), antifungial compounds such

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as fatty acids (Corsetti *et al*., 1998) or phenullactic acid (Lavermicocca *et al*., 2000) and/or bacteriocins (De Vugst and Vandamme., 1994). LAB play an important role in food fermentation as the products obtains with their aid are characterized by hygienic safety, storage stability and attractive sensory property. Many bacteria of different taxonomic branches and in various habitats produce antimicrobial substances that are active against other bacteria. Both Gram negative and Gram positive bacteria produce bacteriocins. Bacteriocins are proteinaceous antibacterial compounds, which constitute a heterologous subgroup of ribosomally synthesized antimicrobial peptides (De Vugst and Vandamme., 1994).

Lactic acid bacteria as probiotics

Lactic acid bacteria were referred to as probiotics in scientific literature by Lilley and Stillwell (1965). However probiotic took on a different terminology when Sperti (1971) used the term probiotic to describe tissue extracts that stimulated microbial growth. Parker (1974) redefined it as organisms and substances that contribute to the intestinal microbial balance. The most recent and accurate description of probiotics was undertaken by Fuller (1989) who redefined it as a live microbial feed supplement beneficial to the host (man or animal) by improving the microbial balance within its body. Another recent definition was by Schrezenmeir and De Vrese (2001) who defined probiotics as viable microbial food supplements which beneficially influence the health of the host. The gastrointestinal tract contains food in different stages of digestion, digestive ferments, liquids and solid waste. Within the gut are also wide ranges of microbes that may be either harmful or beneficial. The beneficial ones assist in the breakdown of food while they also manufacters vitamins essential to the body, breaking down and destroying some toxic chemicals that may have been ingested with the food. Under both healthy and sick conditions, several differnt types of bacteria compete or fight with each other to establish dominance in the warm and moist environment of the alimentary canal that serves as an ecosystem for their survival and propagation.

The average human large intestine harbors over 400 different special of bacteria with a total population far outnumbering even the number of human cells in the body. Under ideal conditions of health and diet, the different strains of bacteria on microflora compete and check the excessive number of any one strain. Healthy condition can be achieved if a balance is maintened between the good and bad bacteria in the ratio of 85 percent to 15 percent. Oral supplement of diet with viable *Lactbacillus acidophilus* of human origin, which is bile resistant, led to a significant decline of three different fecal bacterial enzymes (Goldin and Gorbach *et al*., 1977). This decrease in the fecal bacterial enzyme activity observed in both humans and rats included beta glucuronidase, azoreductase and nitroreductase. All these enzymes catalyse the conversion of procarcinogens to proximal carcinogens in the large bowel leading to colon cancer. Lactic acid bacteria including *Lactobacillus, leuconostoc, lactococcus, pediococcus* and *Bifidobacterium* are found throughout the gastrointestinal tract. The predominant population of lactic acid bacteria in the upper gastrointestinal tract is the *Lactobacillus* species which may colonize the mucosal surface of the duodenum as well as the stomach. *Lactobacillus* and *Bifidobacterium* spp. are prominent members of the commensal intestinal flora and are the commoly studied probiotics bacteria. They cause reduced lactose intolerance alleviation of some diarrhoeas, lowered blood cholesterol, increased immune response and prevention of cancer (Marteau and Ramband, 1993, 1996 Gilliland, 1996; Salminen *et al*., 1998). The selection criteria for probiotic LAB include: human origin, safety, viability activity in delivery vehicles, resistance to acid and bile, adherence to gut epithelial tissue ability to colonise the gastro intestinal tract, production of antimicrobial substances, ability to stimulate a host immune response and the ability to influence metabolic activities such as vitamin production, cholesterol assimulation and lactose activity (Salminen *et al*., 1996). Conway (1996) and Fuller (1989) listed the following organisms as species used in probiotic preparation: *L. acidophilus, L. casei, L. casei* subsp. *rhamnosus, Lactobacillus fermentum, Lactobacillus reuteri Lactococcus lactis* subsp *lactis, L. cremoris, L. bulgaricus, L. plantarum, Streptococcus thermophilus, Enterococcus faecium, Enterococcus faecalis, B. bifidum, B. infantis, B. adolescentis, B. longum, B. breve.*

Probiotics benefit in the gastro intestinal tract and Immune system

Certain LAB species are found not only as components of the human intestinal microflora but also of the man made ecosystem present in fermented food. That is why milks containing viable LAB are known to be beneficial to health acting as prophylaxis against intestinal infections. Thus many investigators have evaluated the effect of yoghurt on the immuno response of animals and humans. Many studies have been conducted on their effect on the incidence and duration of various types of diarrhoe (Isolauri, 2001; Bhatnagar *et al*., 1998). LAB can be effective in preventing gastrointestinal disorders and in the recovery from diarrhoea of miscellaneous causes (Marteau *et al*., 2001). A decrease in the severty and duration of persistent diarrhoea has been reported with LAB (Bhatnagar *et al*., 1998). Guandalini *et al*., (2000) also reported that the administration of *Lactobacillus rhamnosus GG* to 287 children aged 1- 36 months with acute diarrhoea significantly reduced the duration in infected children by rotavirus compared with those receiving placebo. Administration of *Lb rhamnosus* GG also shortened the duration of the hospital stay.

Application of LAB

Lactic acid bacteria are industrially important organisms recognized for their fermentative ability as well as their health and nutritional benefits. Species used for food fermentations belong to the genera *Lactococcus, Streptococcus, Pediococcus, Leuconostoc, Lactobacillus,* and the newly recognized *Corynbacterium.* These organisms have been isolated from grains, green plants, dairy and meat products, fermenting vegetables, and the mucosal surfaces of animals.Once used to retard spoilage and preserve foods through natural fermentations, they have found commercial applications as starter cultures in the dairy, baking, meat, vegetable, and alcoholic beverages industries. They produce various compounds such as organic acids, diacetyl, hydrogen peroxide, and bacteriocins or bactericidal proteins during lactic fermentations not only are these components desirable for their effects on food taste, smell, color and texture, but they also inhibit undesirable microflora. Hence, lactic acid bacteria and their products give fermented foods distinctive flavors, textures, and aromas while preventing spoilage, extending shelf-life, and inhibiting pathogenic organisms. The preservative action of starter culture in food and beverage systems is attributed to the Combined action of a range of antimicrobial metabolites produced during the fermentation process. These include many organic acids such as lactic, acetic and propionic acids produced as end products which provide an acidic environment unfavourable for the growth of many pathogenic and spoilage microorganisms.

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