Available online at www.ijpab.com

ISSN: 2320 – 7051
Int. J. Pure App. Biosci. **3 (2):** 286-290 (2015)

INTERNATIONAL JOURNAL OF PURE & APPLIED BIOSCIENCE

Review Article

OPEN ACCESS

A comprehensive review on Probiotics

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ABSTRACT

The association of probiotics with well-being has a long history. Lactic acid bacteria, belonging to the genus Lactobacillus and Bifidobacterium, have been shown to positively influence health. Together they play an important role in the protection of the organism against harmful microorganisms and also strengthen the host's immunesystem. The use of probiotic bacteria are being considered for various conditions like lactose intolerance, hypertension, constipation etc. The purpose of this paper is to review on the concept and the possible beneficial properties of probiotic bacteria.

Keywords*: Probiotics, Lactobacillus, Bifidobacterium, lactose intolerance*

INTRODUCTION

The word "probiotic" was derived from the Greek word which means "on behalf of ". The concept was introduced by Lilly & Stillwell and was intended to stimulate substances produced by one microorganism to enhance the growth of another. Probiotic therefore is the exact opposite of antibiotic[1].

Probiotic was used later to refer to animal feed supplement, which beneficially affects the host animal by improving its intestinal microbial balance. According to the currently adopted definition by FAO/WHO, Probiotics are: "Live microorganisms which when administered in adequate amounts confer a health benefit on the host". Lactic acid bacteria (LAB) and *Bifidobacteria* are the most common types of microbes used as probiotics, but certain yeastsand bacilli may also be used. Probiotics are commonly consumed as part of fermented foods with specially added active live cultures; such as in yogurt, soy yogurt, or as dietary supplements[2].

The health and nutritional benefits ascribed to probiotics can be generalized under the following categories: maintenance of normal intestinal, maturation of the immune system and development of normal intestinal morphology, micro flora balance in infant and old age, improvement of lactose tolerance and digestibility of the milk products, antitumorogenic activity, reduction of serum cholesterollevels, synthesis of B-complex vitamins, and absorption of calcium. It also shows inhibitory action towards the production of inhibitory compounds such as hydrogen peroxide, Reuterin/Bacteriocins, alteration of pH values by the production of organic acids[3,4].

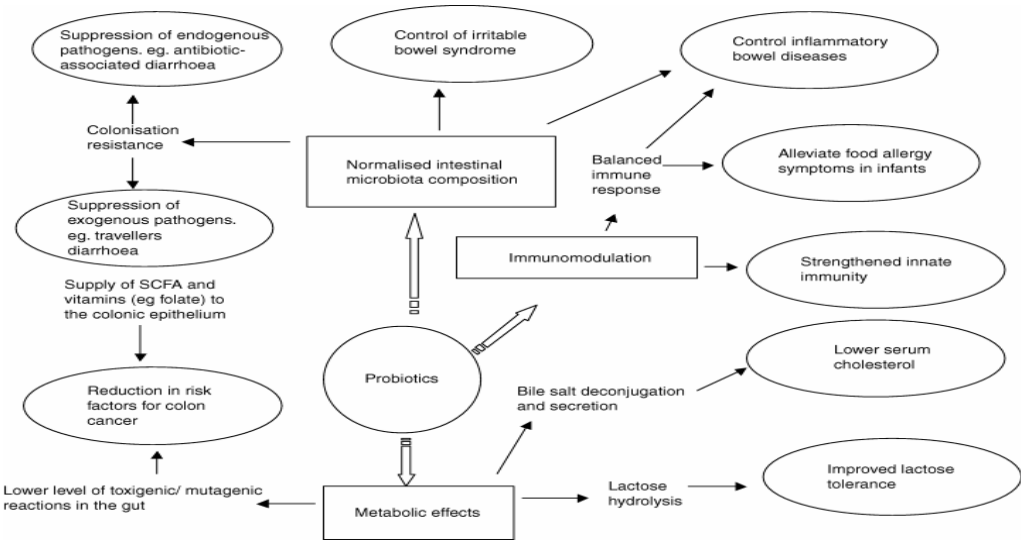
There are various other significance on human health based on newly developed scientific data that reveals reduction of diseases risk and promises to cure various diseases such as Lactose intolerance, Bacterial Vaginosis, Colon cancer, Heart strokes, Cholesterol abnormalities, Chronic disorders. Example of most common probiotic bacteria are such as *Lactobacillu sacidophilus*, *Bifidobacteria*, *Lactobacillu splantarum*, *Lactobacillu spentosus*, *Lactococcus lactis*, *Lactobacillu scasei*, *Bifidobacterium breve*, *Bifidobacterium longum*[5].

Table 1: Commercially used probiotic species[6]

***Lactobacillus* species**	**Bifidobacterium*species***
L. acidophilus	*B. bifidum*
L. casei	*B. breve*
L. fermentum	*B. lactis*
L. gasseri	*B. longum*
L. johnsonii	***Streptococcus* species**
L. lactis	*S. thermophilus*
L. paracasei	
L. plantarum	
L. reuteri	
L. rhamnosus	
L. salivarius	

In vitro methods are usually applied to measure antagonist action of probiotic microorganism against pathogenic bacteria.These methods depend on the bacterium-bacterium antagonism which regulates the proliferation and cell association of one bacterium by the metabolic products produced by the other.The probiotics that are marketed as nutritional supplements and in functional foods, suchas yogurts, are principally the *Bifidobacterium* species and the *Lactobacillus* species[7].

Fig 1:Various Health Benefits from Probiotics consumption[6]



Lactic acid bacteria

Characteristics of Lactic acid bacteria

The lactic acid bacteria (LAB) are rod-shaped bacilli or cocci characterized by an increased tolerance to a lower pH range. This aspect partially enables LAB to outcompete other bacteria in a natural fermentation, as they can withstand the increased acidity from organic acid production (e.g., lactic acid). LAB are catalase negative. LAB are amongst the most important groups of microorganisms used in food industry[8].

Metabolism of Lactic acid bacteria

The method of lactose metabolism varies between different species of lactic acid bacteria. In order to utilize lactose as energy source, bacteria ingest the sugar and move it to the part of the cell which produces lactase. Lactose is broken into its composite parts by the enzyme β-galactose and glucose are then metabolized via different pathways to produce energy in the form of ATP and a number of other molecules, which can include; lactate, ethanol and carbon dioxide[9].

Two main hexose fermentation pathways are adapted by LAB genera. Under conditions of excess glucose and limited oxygen, homolactic LAB catabolize one mole of glucose in the Emden-Meyerhof-Parnas pathway to yield two moles of pyruvate. Intracellular redox balance is maintained through the oxidation of NADH, concomitant with pyruvate reduction to lactic acid. This process yields two moles of ATP per mole of glucose consumed. Representative homolactic LAB genera include *Lactococcus, Enterococcus, Pediococcus*, and group1 Lactobacilli.

Heterofermentative LAB use the pentose phosphate pathway, alternatively referred to as the pentose phosphoketolase pathway. One mole of glucose-6-phosphate is initially dehydrogenated to 6-phosphogluconate and subsequently decarboxylated to yield one mole of CO_2. The resulting pentose-5-phosphate is cleaved into one mole glyceraldehyde phosphate (GAP) and one mole acetyl phosphate. GAP is further metabolized to lactate as in homofermentation, with the acetyl phosphate reduced to ethanol via acetyl-CoA and acetaldehyde intermediates. In theory, end-products (including ATP) are produced in equimolar quantities from the catabolism of one mole of glucose. Obligate heterofermentative LAB include *Leuconostoc*, *Oenococcus, Weissella*, and group III lactobacilli.

Various genera of lactic acid bacteria that can be used as probiotics

Bifidobacterium: Bifidobacteria are normal inhabitants of the human and animal colon. Newborns, especiallythose that are breast-fed, are colonized with bifidobacteria within days after birth.Bifidobacteria were first isolated from the feces of breast-fed infants. Bifidobacteria are located in the entire digestive tract but areespecially abundant in the large intestine. The population ofthese bacteria in the colon appears relatively stable until advanced age, when it seems todecline. They are saccharolytic organisms that produce acetic and lactic acids withoutgeneration of CO_2, except during degradation of gluconate. They are also classified aslactic acid bacteria (LAB). Some of the main varietiesare: *Bifidobacterium breve, Bifidobacterium infantis, Bifidobacterium longum* in children, *Bifidobacterium bifidum, Bifidobacterium longum* in adults.

Lactobacillus, Lactococcus and *Streptococcus thermophilus*

Lactobacilli are normal inhabitants of the human intestine especially in small intestine and vagina. *Lactococcus lactis* (formerly known as *Streptococcus lactis*) is found in dairy products and is commonly responsiblefor the souring of milk. *Steptococcus thermophilus* is also found in milk andmilk products[10]. It is a probiotic and used in the production of yogurt. Some of the main human varieties of*Lactobacillae* are *Lactobacillus acidophilus, Lactobacillus rhamnosus, Lactobacillus plantarum, Lactobacillus brevis* and *Lactobacillus salivarius.*

Enterococcus: Enterococci are part of the intestinal microflora of humans and animals. *Enterococcus faecium SF68* is a probiotic strain that has been used in the management of diarrhea illnesses[11].

Use of lactic acid bacteria in various diseases conditions

Lactose intolerance: The inability of adults to digest lactose, or milk sugar, is prevalent worldwide. People of northern European descent are unique in retaining the ability to produce the lactose-digesting enzyme, lactase, into adulthood so they can continue to drink milk. Consumption of lactose by those lacking adequate levels of lactase produced in the small intestine can result in symptoms oflactose intolerance include bloating, gas, cramps, nausea, diarrhea, abdominal pain and flatulence. These symptoms are due to the undigested lactose reaching the large intestine and being fermented by the colonic microbes, which can produce gases and products that lead to watery stool.The consumption of dairy products – important for supplying calcium and preventing osteoporosis – by people with lactose intolerance can be facilitated by probiotic bacteria.It has been documented scientifically that many lactose intolerant individuals are better able to consume fermented dairy products, such as yogurt, with fewer symptoms than the same amount of unfermented milk, even though yogurt contains about the same amount of lactose as milk. Yogurt was found to aid digestion of lactose because the lactic acid bacteria used to make yogurt produce lactase and digest the lactose before it reaches the colon. In addition to yogurt starter bacteria, *L. acidophilus* and *bifidobacteria* have been shown by several studies to improve digestion of lactose, although generally to a lesser extent than the yogurt starter cultures, *Lactobacillus bulgaricus* and *Streptococcus thermophiles.*

Hypertension: Antihypertensive effects have been documented in animal models and in mildly hypertensive adults for three compounds derived from the growth of certain lactobacilli:

i) Fermented milk containing two tripeptides derived from the proteolytic action of *L. helveticus* on casein in milk.

ii) Bacterial cell wall components from cell extracts of *lactobacilli.*

iii) Fermented milk containing fermentation-derived gamma amino butyric acid.

Systolic blood pressure was decreased on the order of 10-20 mm Hg. These results suggest that consumption of certain lactobacilli, or products made from them, may reduce blood pressure in mildly hypertensive people. Viability of the *lactocillus* is not required for the effect. Such fermentation-derived, but nonprobiotic, products have been developed[12,13].

Antibiotic therapy diseases: The purpose of antibiotics is to kill harmful bacteria. Unfortunately, they frequently kill normal bacteria as well, often resulting in disruption of the bacterial flora, leading to diarrhea and other intestinal disturbances. Replenishing the flora with normal bacteria during and after antibiotic therapy seems to minimize disruptive effects of antibiotic use. Studies show that probiotics can prevent antibiotic associated diarrhea, but that no strong effect on the ability of probiotics to treat diarrhea exists. Not all studies have shown positive results in the prevention of antibiotic associated diarrhea or other symptoms associated with antibiotic therapy.

Vaginosis: The vagina and its microbiota form a finely balanced ecosystem. Disruption of this ecosystem can lead to a microbiological imbalance and symptoms of vaginosis. Vaginosis used to be considered a mere annoyance, but now is being examined for a role in serious conditions including pelvic inflammatory disease, pregnancy-related complications (low birth weight babies, etc.), and increased susceptibility to AIDS infection. Vaginosis can be caused by several different organisms, and in many cases, the causative agent may not be identified. Lactobacilli predominate in the healthy vagina, and a lack of lactobacilli (especially those producing hydrogen peroxide) is a risk factor for vaginosis. The lactobacilli are thought to maintain a favorable vaginal pH in the acidic range and to inhibit pathogens, possibly through the production of hydrogen peroxide and other antimicrobial factors. Intravaginal applications of lactobacilli have been somewhat effective in treating bacterial vaginosis. One study done with 13 women showed that consumption of yogurt containing *L. acidophilus* decreased the incidence of *Candida* yeast infections. Research suggests that lactobacilli may be helpful in controlling the incidence and duration of vaginal infections, but larger, controlled studies are needed[13].

Constipation: Functional constipation is a prevalent, burdensome gastrointestinal disorder whose treatment remains challenging. Probiotics have been increasingly investigated in its management[14]. Milk products fermented with some strains of *L.acidophilus* and *bifidobacteria* shorten intestinal transit time. This effect may be useful for those with constipation, such as the elderly[15]. A well-controlled human study is needed to confirm this.

Small bowel bacterial overgrowth: Under certain conditions, such as during the production of low stomach acid or kidney dialysis, microbial populations in the small intestine can increase beyond normal levels. This is termed small bowel bacterial overgrowth. Growth of the misplaced microbes can produce potentially toxic byproducts. Researchers have found that feeding high levels of certain probiotic strains can control the toxic effects of these microbes. This is another example of the ability of probiotic strains fed in high numbers to modulate the activity of other intestinal bacteria.

Elevated blood cholesterol: Cholesterol is essential for many functions in the human body. It acts as a precursor to certain hormones and vitamins and is a component of cell membranes and nerve cells. However, elevated levels of total blood cholesterol or other blood lipids are considered risk factors for developing coronary heart disease. Although humans synthesize cholesterol to maintain minimum levels for biological functioning, diet also is known to play a role in serum cholesterol levels. The extent of influence varies significantly from person to person. Probiotic cultures have been evaluated for their effect on serum cholesterol levels. Clinical studies on the effect of lowering cholesterol or low-density lipid levels in humans have been inconclusive.

Some human studies suggest that elevated blood cholesterol levels can be reduced by consumption of probiotic-containing dairy foods, but the evidence is not overwhelming. It is likely that some strains may demonstrate this property while others do not. The dietary cholesterol absorption is reduced in three ways: assimilating, binding, or degradation. Probiotic strains assimilate the cholesterol for their own metabolism. Probiotic strains can get to the cholesterol molecule, and can degrade cholesterol to its catabolic products. The cholesterol level can be reduced indirectly by deconjugating the cholesterol to the bile acids, thereby reducing the total body pool[13].

CONCLUSION

Probiotics have been extensively studied and exploredcommercially in many different products in theworld. Recent studies have suggested that probioticshave demonstrated beneficial effects to human and animalhealth. The reported beneficial effects of probiotic consumption include improvement of intestinal health, amelioration of symptoms of lactose intolerance, and reduction of the risk of various other diseases. Despite the promising evidence, the role of probiotics in human health as well as the safety of their application should be further investigated.

REFERENCES

1. Ahmed.T and Kanwal.R.Biochemical Characteristics Of Lactic acid Producing Bacteria and preparation Of Camel Milk Cheese By Using Starter Culture.*Pakistan Vet J*, **24(2)**: 87-91 (2004)
2. Culligan.P.E, Hill Colin, Sleator.D.Roy.Probiotics and gastrointestinal disease: Successes, Problems and Future Prospects, pp1-19, (2009)
3. Fuller. R, Probiotics in man and animals: A review.*J.Appl.Bacteriol*, **66(5)**: 365-368 (1989)
4. Gourama. H,&L.B.Bullerman.Antimycotic and antiflatoxigenic effect of *Lactic*acid Bacteria.A review.*J. Food production*, **58(11)**: 1275-1280 (1995)
5. Czerucka.D, Piche.T, Rampal.P, Review Article Yeast as Probiotics- Saccharomyces boualrd, *Alimentary pharmacology and therapeutics*, **20**: 30-35, (2007)
6. Parvez S., Malik K.A., Ah Kang, Probiotics and their fermented food products are beneficial for health. *Journal of Applied Microbiology*, **100(6)**: 1171-1185 (2006)
7. Sahi T. Genetics and epidemiology of adult-type hypolactasia. *Scand J Gastroenterol Suppl*, **29**: 202–220 (1994)
8. Isolauri E, Juntunen M, Rautanen T, Sillanaukee P, Koivula T. A human Lactobacillus strain (Lactobacillus casei sp. Strain GG) promotes recovery from acute diarrhea in children. *Pediatrics*, **88**: 90-97 (1991)
9. Bayless TM. Lactose malabsorption, milk intolerance, and symptom awareness in adults. In: Paige DM, Bayless TM, eds. Lactose digestion: clinical and nutritional implications. Baltimore: Johns Hopkins University Press, 117–23 (1981)
10. Bayless TM. Lactose malabsorption, milk intolerance, and symptom awareness in adults.In: Paige DM, Bayless TM, eds. Lactose digestion: clinical and nutritional implications. Baltimore: Johns Hopkins University Press, 117–23, (1981)
11. Scrimshaw NS, Murray EB. The acceptability of milk and milk products in populations with a high prevalence of lactose intolerance. *Am J Clin Nutr*, **48**: 1079–159 (1988)
12. Nanji AA, Khettry U, Sadrzadeh SMH. Lactobacillus feeding reduces endotoxemia and severity of experimental alcoholic liver (disease). *Proc Soc ExpBiol Med*, **7**: 205-243 (1994)
13. Schrezenmeir J, de Vrese M. Probiotics, prebiotics and synbiotics—approaching a definition. *Am J Clin Nutr*, **73**: 361–364 (2004)
14. EiriniDimidi, StephanosChristodoulides, Konstantinos C Fragkos, S Mark Scott, and Kevin Whelan, The effect of probiotics on functional constipation in adults: a systematic review and meta-analysis of randomized controlled trials. *Am J Clin Nutr*. **100(4)**: 1075-1084 (2014)
15. PalomaresIniguez.C, Morales-Perez.R, Felix-Acedo.E, Evaluation of Probiotic Properties in Lactobacillus Isolated from Small intestine of Piglets, *Rev LatinoamMicrobiol*, **49(3-4)**: 46-54 (2007)