DOI: 10.21276/sajb.2016.4.6.18

Scholars Academic Journal of Biosciences (SAJB) **ISSN 2321-6883 (Online)**
Sch. Acad. J. Biosci., 2016; 4(6):549-554 **ISSN 2347-9515 (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Review Article

A Review on Probiotics

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Abstract: Probiotics are living microorganisms mostly bacteria that, when administered in adequate amounts, confer a health benefit on the host. Benefits of probiotics have been explored over centuries. Many probiotics are culturable components of the microbiota that have been used for their beneficial functions since long before the term "probiotic" was coined. The most commonly used probiotic strains include the Lactic Acid Bacteria (LAB), Gram-positive microbes that have been used for centuries in food production processes (yogurt, cheese, Pickles). Market value and biological potential of probiotics is increasing day by day because of their health-promoting properties. The aim of this paper is to classify those good bacteria which will help in selecting the probiotic microorganisms in a more rational manner for further applications.
Keywords: probiotics, Lactic Acid Bacteria, Gram-positive microbes

INTRODUCTION

Probiotics are also called friendly or good Bacteria. It is basically used as complementary and alternative medicines. Probiotics are not the same thing as prebiotics. When prebiotics and probiotics are mixed together they form symbiotic. Probiotics are available in fruits and dietary supplements, where the bacteria may have been present originally or added during preparation. Most often bacteria come from different groups. In each group there are different species, and within each species there are different strains[1].

Friendly bacteria are vital to proper development of the immune system to protect against microorganisms that could cause a disease, and to the digestion and absorption of food and nutrients.

Probiotics must have undergone controlled evaluation to document help benefits in the target hosts. Only products containing life organisms should be reproducible human studies to confer a health benefit can actually claimed to be probiotics.

PROBIOTICS HISTORY

In 1899 Henry Tissier of the Pasteur Institute first isolated another important probiotic bacterium called *Bifidobacterium*, at the Pasteur Institute in Paris [2].

Grigoroff [3] Cultivated *Lactobacillus bulgaricus*. frompodkvassa used as a starter for production of the Bulgarian kiselomleko (sour milk or yahourth)

Grigoroff [3] also identified another organism, *Streptococcus thermophilus*, which received no attention since; it was considered a pathogen at that time.

Russian scientist and Nobel laureate Elie Metchnikoff [2] first introduced the probiotic concept in 1908. He proposed the idea that "intestinal auto-intoxication" is caused by putrefactive or proteolytic bacteria that generate toxins in the large bowel. Metchnikoff suggests that fermented milk produce good bacteria (*Bulgarian bacillus)* in the gut which suppressed harmful microbes.

In 1915 B.W. Hammer first isolated and described as *Bacillus coagulants* at the Iowa Agricultural Experiment Station [3].

In 1917, during a shigellosis outbreak, German professor Alfred Nissle isolated [3] a strain of *Eschericia coli* from a soldier who was not affected by the disease. He then used this to treat people suffering from shigellosis and acute gastrointestinal salmonellosis.

In 1930 suit with Minoru Shirota in Japan, recognized the importance of the preventive medicine and modulation of the gastrointestinal microflora. They

succeeded in isolating and culturing a *Lactobacillus* strain capable of surviving the passage through the gastrointestinal tract. The culture identified as *Lactobacillus casei* strain Shirota was successfully used for the production of the fermented dairy product called Yakult, which initiated the foundation of the same company in 1935.

The term "probiotics" was first introduced in 1953 by Werner Kollath to describe organic and inorganic food supplements applied to restore health to patients suffering from malnutrition. Later intestinal lactic acid bacterial species with alleged health beneficial properties have been introduced as probiotics, including *Lactobacillus rhamnosus*, *Lactobacillus casei*, and *Lactobacillus johnsonii*[2-4].

TYPES OF GOOD BACTERIA

The Classification of bacteria is done in terms of kingdom because of its peculiar cellular and morphological characteristics. There are different types of bacteria that share classic morphological characteristics of the kingdom, but are classified differently in different groups on basis of the habital. Good bacterias are of following types[5-7]-

1) Lactobacillus
2) Bifidobacterium
3) Bacillus coagulans
4) Streptococcus

Lactobacillus

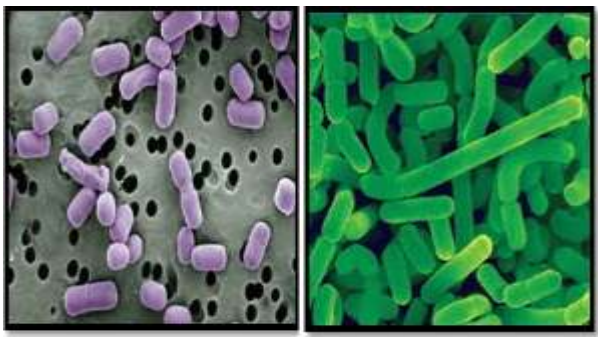

Fig-1: *Lactobacillus*

It is a gram- positive, facultative, anaerobic bacterium. There are more than 80 species of the Lactobacillus genus of probiotics. It is a member of a lactic acid bacteria group. In humans they are part of the vaginal microbiota. Lactobacilli are often considered to be commensal or beneficial participants in human microbial ecology and considerable research is being carried out on the effects for the use of lactobacilli as additives in both human and animal diets. Lactobacilli are highly competitive largely due to their applications in the production of fermented food. They can also produce antimicrobial substances including bacteriocins that have ability to inhibit pathogenic and food spoilage bacteria.

Scientific classification of Lactobacillus is given below-

Kingdom: Bacteria
Phylum: Firmicutes
Class: Bacilli
Order: Lactobacillales
Family: Lactobacillaceae
Genus: *Lactobacillus*
Good Species: *acidipiscis*
acidophilus
brevis
buchneri
casei
collinoides
crispatus
delbrueckii
Sub sp. *bulgaricus*
delbrueckii
Sub sp. *lactis*
fermentum
fructivorans
gallinarum
gasseri
helveticus
hilgardii
iners
jensenii
johnsonii
kefiranofaciens
kimchii
manihotivorans
mucosae
paracasei
parakefiri
paraplantarum
plantarum
pontis
reuteri
rhamnosus
sakei
salivarius
sanfranciscensis
etc.

Uses as probiotics

Most Lactobacillus species in humans are considered harmless. Lactobacillus is used for treating and preventing diarrhea, including infectious types such as rotaviral diarrhea in children and traveler's diarrhea. It is also used to prevent and treat diarrhea associated with using antibiotics. *Lactobacillus acidophilus* resides in the intestine which helps indigestion [8]. Some people use lactobacillus for irritable bowel syndrome (IBS); colic in babies; Crohn's disease; inflammation of the colon; and a serious gut problem called necrotizing enterocolitis (NEC) in babies born prematurely[9].

It is also used to prevent the common cold in adults, and to prevent respiratory infections in children

attending daycare centers. It is also being tested to prevent serious infections in people on ventilators.

Some Lactobacillus species have potential therapeutic properties such as anti-cancer activities. It can also be used to restore vaginal ecosystem and protect vaginal epithelium.

Some Lactobacilli helps in hormone secretion. One strain was effective in the treatment of diabetes mellitus.
Lactobacillus also has variety uses in the production of yogurt, cheese, pickles, beer, wine, eider, cocoa, kefir etc.

It is also used for high cholesterol, lactose intolerance, Lyme disease, hives, and to boost the immune system.
Some Lactobacilli also have been associated with dental carries.

Lactobacillus is used for skin disorders such as fever blisters, canker sores, eczema, and acne.

Bifidobacterium

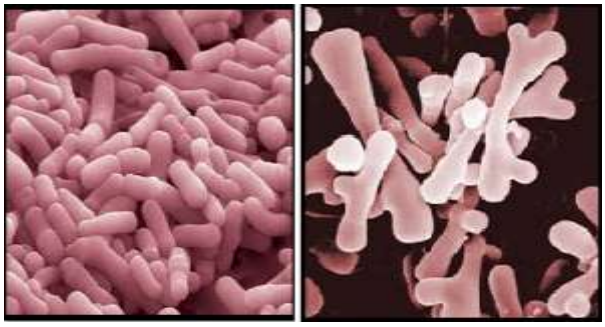

Fig-2: *Bifidobacterium*

Bifidobacterium is a grampositive, nonmotile, and anaerobic bacteria. Previously it was referred to as*Lactobacillus bifidus*. Bifidobacteriumdon't live out in the open, as they can't tolerate oxygen rich environment. The genus bifidobacterium possess a unique fructose-6- phosphate phosphoketolase pathway employed to ferment carbohydrates.

Some bifidobacterium strains exhibit various types of oxic growth. Low concentration of O_2 and CO_2 can have a stimulatory effect on the growth of these bifidobacterium strains. The bifidobacterium species were classified into four classes: O_2- hypersensitive, O_2-sensitive, O_2- tolerant, and microaerophilic.

To date, about 32 different bifidobacterium species have been identified, and most of them have similar genetic makeup. Bifidobacterium are found in the human gastro intestinal (GI) tract, and the female vagina, and urogenital tract. They are found in the highest numbers in the colon (large intestine)[9].

Scientific classification of Lactobacillus is given below-
Kingdom: Bacteria
Phylum: Actinobacteria
Class: Actinobacteria
Subclass: Actinobacteridae
Order: Bifidobacteriales
Family: Bifidobacteriaceae
Genus: *Bifidobacterium*
Good Species: *animalis*
asteroides
bifidum
breve
dentium
infantis
longum
Merycicum
ruminantium
thermacidophilum
tsurumiense etc.

Uses as probiotics

Some *Bifidobacterium* strains are considered as important probiotics and used in the food industry. Some of its strains help in regulation of Intestinal microbial homeostasis. *Bifidobacterium* improve the gut mucosal barrier and lowers levels of lipopolysaccharide in the intestine[9].

B. lactis for short is just one of the many bacterial strains found to promote overall health and well-being. This powerful probiotic is essential if you want to experience good health. *Bifidobacterium lactis* is one of the most versatile and hardest working for the human body [9]. Similarly to other strains, these lactic acid bacteria can help fight lactose intolerance and boost the immune system.

In addition to these benefits, *Bifidobacterium lactis* may also support healthy cholesterol levels, ease ulcerative colitis, as well as a condition called pouchitis, which sometimes develops after surgery for ulcerative colitis, and even combat the effects of celiac disease. Not only can *Bifidobacterium lactis* help digest lactose, it's an integral aspect of supporting overall digestion of all sugars, fibers, and macronutrients. In addition to these benefits, *Bifidobacterium lactis* may also help reduce the occurrence of antibiotic-associated diarrhea. This can be a huge help in the case of emergencies when antibiotics may be necessary.

Research is currently ongoing to clarify the role of *Bifidobacterium bifidum* in treating certain health conditions and the best way to increase the production of helpful colonies of this probiotic within the human body. A study done concerning the effects of *Bifidobacterium bifidum* on neonatal necrotizing entercolitis (NEC) , one of the chief causes of death in premature babies, showed some promising results. Another intriguing study, concerning the effect of *Bifidobacterium bifidum* in controlling allergic diseases,

involved newborns of families with a history of eczema. *Bifidobacterium bifidum* could be a great weapon in controlling diseases caused by allergic response.

Other uses for Bifidobacteria include treating a skin condition in infants called atopic eczema, yeast infections (candidiasis), cold, flu, reducing flu-like symptoms in children attending day-care centers, breast pain (mastitis), hepatitis, lactose intolerance, mumps, Lyme disease, and cancer[10].

Bacillus coagulans

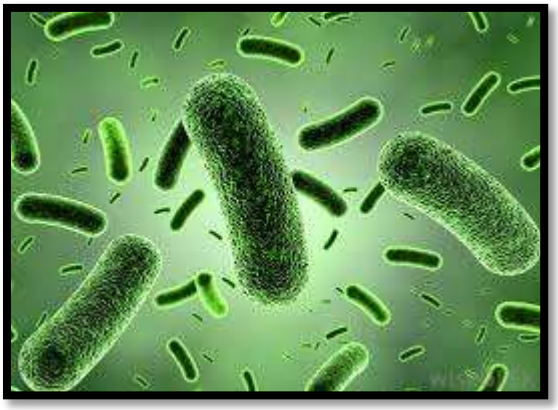

Fig-3: *Bacillus coagulans*

*Bacillus coagulan*s having genus bacillus is a lactic acid forming bacteria. B.W. Hammer at first isolated it at the lowa agricultural experiment station when there occurred an outbreak of coagulation in the evaporated milk packed by allow acondensary.

It is basically a gram positive bacterium, but may appear gram negative when entering the stationary phase of growth.

It was also separately isolated in 1935 in the 5th edition of Bergey's manual as [8], *Lactobacillus sporogenes*.

It has characteristics of both genera Lactobacillus and Bacillus. There is a contradiction over its taxonomic position between the families Lactobacillaceae and Bacillaceae. Until 1974 it was classified as *Lactobacillus sporogenes*.

Like other Bacillus species that are sometimes called "soil organisms". During unfavorable conditions they are able to form endospores, which are very tough outer shells. But in favourable condition of growth the endospores germinate into vegetative cells which can rapidly multiply.

As it has a whip-like propelling feature it can move independently.

Scientific classification of *Bacillus coagulan*s is given below-
Kingdom: Bacteria

Phylum: Firmicutes
Class: Bacilli
Order: Bacillales
Family: Bacillaceae
Genus: *Bacillus*
Good Species: *coagulans*

Uses as probiotics

The bacterium is used in veterinary applications. The bacterium is also used for human being. This is used to improve vaginal flora, improving abdominal pain and bloating in irritable bowel syndrome patients and increasing immune response to viral challenges. The bacterium is also very effective to treat and prevent strongly recurrence clostridium difficile associated diarrhea. This is also helpful to prevent diarrhea including infectious type such as rotaviral diarrhea in children, traveller's diarrhea, and diarrhea caused by anti-biotics.

The spores of this bacterium are activated in acidic medium and are used as probiotics for antibiotic treatments. These spores are germinated in stomach in the acidic environment. It is also useful to prevent cancer and also helpful to prevent the formation of cancer causing agents. It is also added to some vaccines as additive to improve their effectiveness.

Some people use *Bacillus coagulans* to prevent respiratory infections and ramp up the immune system. Some people use *Bacillus coagulans*to prevent respiratory infections and ramp up the immune system. Taking a *Bacillus coagulans* probiotic supplement can help to restore balance to the gut microflora following a disruption. This bacterium is able to survive the harsh, acidic conditions of the gastrointestinal tract and colonize the intestines when supplemented orally [8].

Bacillus coagulans has also been shown to be beneficial in treating BV (Bacterial Vaginosis) and helped reduce residual inflammation of treated HV-1 infection patients[11].

Streptococcus

Fig-4a: *Streptococcus salivarius*

Fig-4b: *Streptococcus thermophilus*

Streptococcus is not just bad bacteria that cause disease, but some *Streptococcus*is also used as probiotics for disease prevention. *Streptococcus* is a gram-positive,non-sporulating, spherical-shaped, bacteria belonging to the phylum Firmicutes. Cell division in this genus occurs along a single axis in these bacteria, and thus they grow in chains or pairs.

Most are oxidase-negative and catalase-negative, and many are facultative anaerobes. Species of *Streptococcus* are classified based on their hemolytic properties.

Alpha-hemolytic species cause oxidization of iron in hemoglobin molecules within red blood cells, giving it a greenish color on blood agar.

Beta-hemolytic species cause complete rupture of red blood cells. Beta-hemolytic streptococci are further classified by Lancefield grouping.

Streptococci have been divided into six groups on the basis of their 16S rDNA sequences: *Streptococcus. anginosus, Streptococcus bovis, Streptococcus mitis, Streptococcus mutans, Streptococcus pyogenes* and *Streptococcus salivarius.*

The 16S groups have been confirmed by whole genome sequencing. Streptococci are found in many environments in nature. In people, they normally live on your skin and on your mucous membranes inside our body, but they can translocate to inner tissues.

Streptococcus salivarius is considered as the opportunistic pathogen, rarely finding its way into the bloodstream, where it has been implicated in cases of sepsis in people with neutropenia (a deficiency in white blood cells)[12,13].

Scientific classification of *Streptococcus* is given below-

Kingdom: Bacteria
Phylum: Firmicutes
Class: Bacilli
Order: Lactobacillales
Family: Streptococcaceae
Genus: *Streptococcus*
Good Species: *salivarius*
Thermophilus

Uses as probiotics

Streptococcus salivarius: Streptococcus salivarius is initially famous for its broad inhibitory activity against *Streptococcus pyogenes, but it is also provide more diverse health benefits which are ranging from t*he alleviation of halitosis to stimulation of antiviral immune defenses.

The first *Streptococcus salivarius* strain is K12, which is commercially developed as a probiotic in 2001[1]. Although *Streptococcus salivarius* is not commonly consumed as a naturally occurring food ingredient, it is nevertheless considered a low-risk organism since, in spite of its apparently invariable and plentiful presence in the human oral cavity. A distinctive feature of strain K12 was its production of two novel lantibiotics (salivaricin A2 and B) (*Lantibiotics are gene-encoded peptides that contain intramolecular ring structures, introduced through the thioether containing lanthionine and methyllanthionine residues)* , both of which were shown *in vitro* to have inhibitory activity against *Streptococcus pyogenes.*

Streptococcus salivarius is a prominent member of the oral microbiota and has excellent potential for use as a probiotic targeting the oral cavity. Two types of *Streptococcus salivarius* bacteria found in the mouth may have benefits in the dentistry and oral care arenas, *Streptococcus salivarius* K12 and *Streptococcus salivarius* M18**.** *Streptococcus salivarius* produces three types of antimicrobial agents: Salivaricin A, Salivaricin B and Salivaricin 9. *Streptococcus salivarius* is known to be a pioneer colonizer of infants, who typically acquire it from their mothers shortly after birth.

Streptococcus salivarius K12 was assessed to be moderately resistant to both gentamicin and ofloxacin. Eight additional *Streptococcus salivarius* isolates from different individuals were also tested for sensitivity to gentamicin and ofloxacin to help determine the level of resistance to these antibiotics in the general *Streptococcus salivarius* population. Each displayed moderate levels of resistance to gentamicin and ofloxacin, similar to that of strain K12. Thus, *Streptococcus salivarius* K12 is sensitive to a variety of commonly utilized antibiotics. M18 is effective in preventing acid erosion caused by foods with high acidity that would otherwise eat away the tooth enamel.

Streptococcus thermophilus: Streptococcus thermophilus is a strain of probiotic bacteria that is found in milk, cheese and yogurt products. It improves digestion, increased resistance to infection, and enhanced balance in microbiota. These organisms break down lactase which helps in digestion of milk products.

Research has also shown that *Streptococcus thermophilus* synthesizes antibiotic chemicals that fight the spread of harmful bacteria in the gastrointestinal tract. It may aid in preventing infections such as *Clostridium difficile* and upper respiratory tract infections like pneumonia, and generally support immune function.

Streptococcus thermophilus is used to improve non-breast fed infant healthy probiotic ratio in the gut and helps decrease baby colic. It can help to establish a healthy microflora in infants who normally derive these bacteria from their mother's breast milk. It also helps to prevent rotavirus diarrhea.

This bacterium also exhibits a number of anti-cancer mechanisms *Streptococcus thermophilus* has been shown to produce folate (Vitamin B9) and is often added to milk products to increase folate levels, as the human body does not produce folate. Folate is used to synthesize DNA (Deoxyribonucleic acid), repair DNA, and methylate DNA. Folate also aids rapid cell division and growth; is a very important nutrient especially during infancy and pregnancy. Folate is also needed to produce healthy red blood cells to prevent anemia in both children and adults.

This probiotic is also combined with other probiotics to improve quality and longevity of food products. Some other uses of *Streptococcus thermophilus is, it* decrease ulcerative colitis symptoms, decrease leaky gut symptoms, decrease AIDS symptoms, fight Clostridium difficile, decrease chance of kidney stones, and increase anti-tumor activity.

CONCLUSION

The beneficial effects of probiotics likely result from several complexes, interacting mechanisms that will differ for different strains and sites of action. That's why although the result of probiotics is very promising, the routine use of probiotics for the prevention of disease is not recommended until further trials determine the strain and dose required. The overdose of it sometimes may cause harmful effects. This good bacterium has open a new chapter is medical science. Research on it is just going on. Scientists are trying to find some new probiotics which may help in preventing fatal diseases like Cancer, AIDS etc.

ACKNOWLEDGEMENT

I am highly obliged to Mr. Arnab Acharyya for his continuous support in completing this paper. I am greatly indebted to Mr. Tapas Kumar Saha, Chairman of Governing Body, Technique Polytechnic Institute, Hooghly, West Bengal, India, for allowing me to use their computer, and other Equipment for fulfillment of the entire project.

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