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REVIEW ON PROBIOTICS

[1]Dr.D.Rama Brahma Reddy,[2]P.Sukanya, [3]G.Prathibha
[1]Department of Pharmaceutics, Nalanda institute of pharmaceutical sciences,Siddharth Nagar, Kantepudi (V), Sattenapalli (M), Guntur (DIST)-522438,AP,India.
[2]Department of Phytochemistry, Nalanda institute of pharmaceutical sciences,Siddarth Nagar, Kantepudi(V), Sattenapalli(M), Guntur (DIST)-522438,AP,India.
[3]Student of B.Pharmacy, Nalanda institute of pharmaceutical sciences, siddarth Nagar, Kantepudi (v), Sattenapalli(M), Guntur (DIST)-522438,AP, India.

Abstract:
The term "probiotic" was first used in 1965, by Lilly and Stillwell, to describe substances secreted by one organism which stimulate the growth of another. The use of antibiotics, immunosuppressive therapy and irradiation, amongst other means of treatment, may cause alterations in the composition and have an effect on the GIT flora. Therefore, the introduction of beneficial bacterial species to GI tract may be a very attractive option to re-establish the microbial equilibrium and prevent disease. Prebiotic is a non-digestible food ingredient that confers benefits on the host by selectively stimulating one bacterium or a group of bacteria in the colon with probiotic properties. Both probiotics and prebiotics are together called as Synbiotics. Various bacterial genera most commonly used in probiotic preparations are *Lactobacillus, Bifidobacterium, Escherichia, Enterococcus, Bacillus* and *Streptococcus*. Some fungal strains belonging to *Saccharomyces* have also been used. Probiotics have been shown to be effective in varied clinical conditions-ranging from infantile diarrhoea, necrotizing enterocolitis, antibiotic-associated diarrhoea, relapsing *Clostridium difficle* colitis, *Helicobacter pylori* infections, inflammatory bowel disease to cancer, female uro-genital infection and surgical infections. *Lactobacillus rhamnosus* strain GG has proven beneficial affects on intestinal immunity.

Keywords: Probiotics,Lactobacillus,Bifidobacterium,Diarrhoea.

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.

What are probiotics?
Probiotics are live microorganisms that are intended to have health benefits when consumed or applied to the body. They can be found in yogurt and other fermented foods, dietary supplements, and beauty products. Cases of severe or fatal infections have been reported in premature infants who were given probiotics, and the U.S. Food and Drug Administration (FDA) has warned health care providers about this risk.

Although people often think of bacteria and other microorganisms as harmful "germs," many are actually helpful. Some bacteria help digest food, destroy disease-causing cells, or produce vitamins. Many of the microorganisms in probiotic products are the same as or similar to microorganisms that naturally live in our bodies.

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

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3) Bacillus coagulans
4) Streptococcus

1.1.Lactobacillus

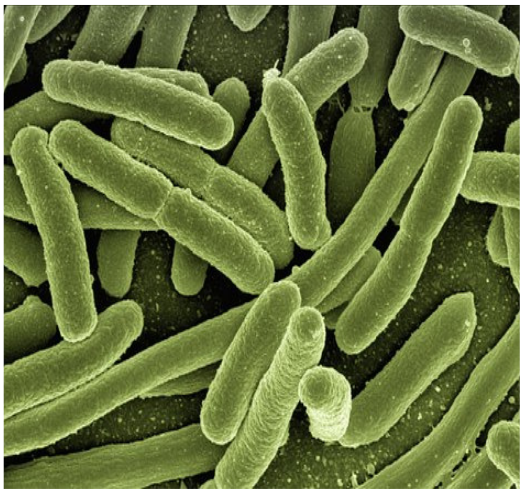

Fig-1: Lactobacillus

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
Sub sp. Bulgaricus,delbrueckii

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).

1.2. Bifidobacterium

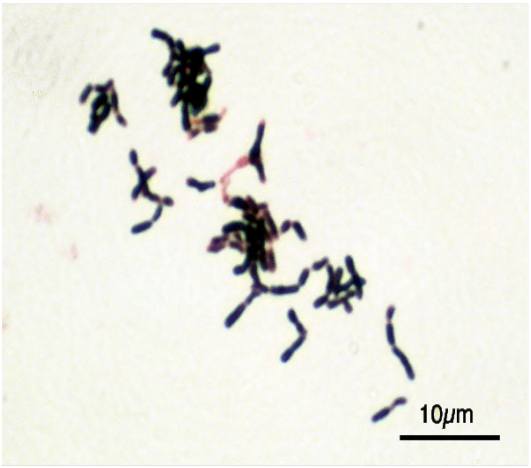

Fig-2: Bifidobacterium

Bifidobacterium is a grampositive, nonmotile, and anaerobic bacteria. Previously it was referred to asLactobacillus 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 O2 and CO2 can have a stimulatory effect on the growth of these bifidobacterium strains. The bifidobacterium species were classified into four classes: O2-hypersensitive, O2-sensitive, O2- 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

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Good Species:animalis,asteroides

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.

1.3.Bacillus coagulans

Fig-3: Bacillus coagulans

Bacillus coagulans 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 coagulans 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.

1. 4. Streptococcus

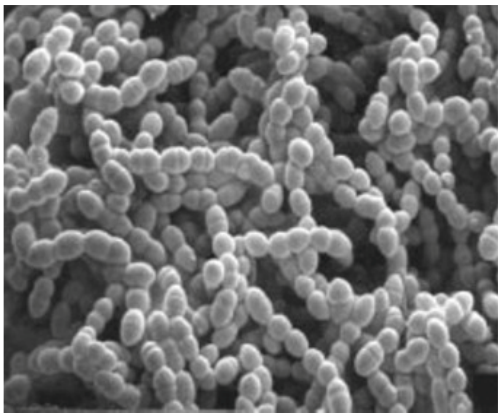

Fig-4: Streptococcus salivarius

Streptococcus is not just bad bacteria that cause disease, but some Streptococcusis also used as probiotics for disease prevention. Streptococcus is a gram-positive,non-sporulating, spherical-shaped, bacteria belonging to the phylum

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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. 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
Good Species: salivarius,Thermophilus

Uses as probiotics

Streptococcus salivarius:

Streptococcussalivarius is initially famous for its broad inhibitory activity against Streptococcus pyogenes, but it is also provide more diverse health benefits which are ranging from the 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 andStreptococcus salivarius M18.

Probiotic Foods: Which Foods Are The Best Sources?

A variety of plant-based foods, particularly **sour and fermented foods**, contain beneficial, probiotic bacteria.

Some of the best probiotic foods include:

- **Sauerkraut**: A form of fermented cabbage, sauerkraut is full of probiotics created during the fermentation process. Freshly fermented is best, as it maintains the most nutrient density.
- **Kimchi**: This traditional Korean food is made using fermentation with cabbage and other veggies.
- **Tempeh**: A fermented soybean product that's high in both protein and probiotics.
- **Miso**: A staple in Japanese cuisine, miso paste is commonly used as a base for soups and as a flavoring in many dishes. While rich in probiotics, it's also high in sodium so it may be best used in moderation.
- **Natto**: An unusual food with a unique texture and flavor, Natto is made from fermented soybeans and is rich in probiotics.
- **Kefir**: A cultured, probiotic food typically made with cow's milk. To avoid the negative health effects of dairyyou can opt for coconut or water-based versions instead.

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- **Yogurt**: To stay plant-based, choose non-dairy varieties, which can also have probiotics. Steer clear of sweetened varieties because sugars can be bad for your digestive health.

Fig-5 the best probiotic foods

Role of probiotics in promoting human health

Probiotics are used for the management of an array of disorders and unusual physiological conditions. There is enough evidence indicating the potential of various probiotic strains in the treatment of a number of health issues including gastrointestinal issues, tumors, respiratory issues, etc. The swift advancement of microbiome science has resulted in various applications of probiotics and prebiotics. Synbiotics, a combination of probiotics and prebiotics, are being formulated to enhance their efficacy. Probiotics are now under investigation for their potential in treating obesity, metabolic syndrome, respiratory infections, and COVID-19. Probiotics and prebiotics are projected to reach approximately $50 billion in sales and manufacturing within a few years (Bodke and Jogdand, 2022). This increase signifies consumer knowledge of gastrointestinal health and its impact on overall well-being. As the microbiome is comprehended more thoroughly, these products may enhance neurological and cancer preventive results. Recent studies on probiotics and prebiotics are uncovering their potential roles in neurobiology and cancer prevention. The search results do not address probiotics and prebiotics in neurobiology; nonetheless, the gut-brain axis is receiving increased attention in research. This study indicates that gut microbiota may influence brain function and behavior, potentially impacting depression, anxiety, and neurodegenerative diseases. Probiotics and prebiotics influence gut microbiota, perhaps benefiting neurological health.

Probiotics for treatment of GI tract issues

Probiotics can be effectively used for the treatment of lactose intolerance, gastrointestinal and urogenital infections, ulcerative colitis, gastrointestinal tumors and Chrohn's disease. Probiotics compete with pathogens for the binding site at epithelial tissue and some synthesize biochemicals that inhibit the growth of pathogens. *Lactobacillus plantanum* effectively prevents bloating and abdominal pain, *S. boulardii* is used for the treatment of diarrhea and for improving overall gut functioning (Iannitti and Palmieri, 2010).

Probiotics for diabetes

Probiotics can effectively modulate gut hormones, the hormones are known for controlling homeostasis, their modification neutralizes the resistance to insulin which is the major cause of type 2 diabetes. There are some probiotics that can reduce the growth of adipocytes which aids in the prevention of a range of metabolic disorders.

Probiotics for UTI Urinary Tract Infections (UTI) result from an imbalance in vaginal microbiota. It is quite common in both elder and young women. It can be both upper UTI and lower UTI. It is recurrent problem and prophylactic antibiotics can sometimes be beneficial but there is a risk of resistance development. Lactic acid bacteria have been found in the vaginal swab of many women are quite effective in lowering the pH. For treating UTI there are over 50 probiotics that can effectively treat UTI, all these are based on *Lactobacillus* spp. i.e. *Lactobacillus brevis*, *L. reuteri*, *L. vaginalis*, *L. rhamnosus* .

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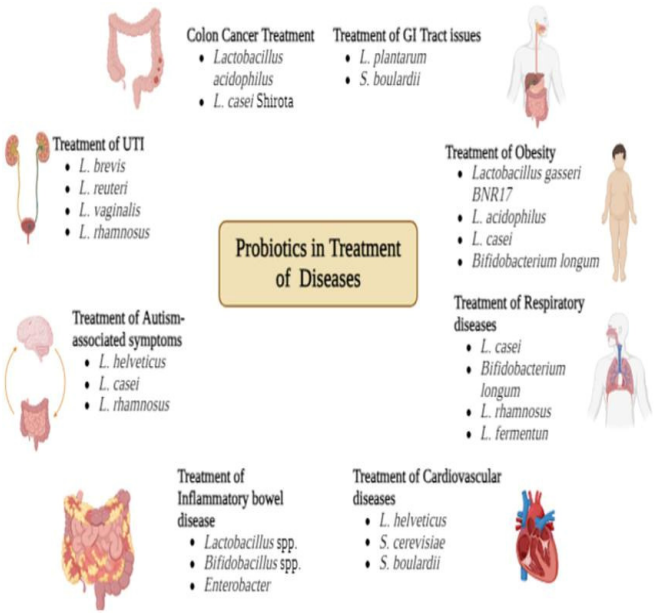

Fig-6: Probiotics in treatment of diseases

Probiotics for obesity

Genetic variability, energy intake and expenditure imbalance are the major reasons for obesity which is a growing issue in these times. Adiponectin and leptin are present in adipocyte tissues and these are majorly responsible for obesity, *Lactobacillus gasseri* BNR17 inhibits their growth. Probiotics stimulate the adrenergic nervous system which generates a thermogenic response, this facilitates weight loss. Certain probiotics like *Lactobacillus acidophilus, L. casei, Bifidobacterium longum* exhibit hypocholesterolemic activity, they reduce the level of triglycerides, Low Density Lipids (LDL) and High Density Lipids (HDL).

Probiotics for angiogenesis

New vessels are regenerated from old vessels via angiogenesis, it aids in faster wound healing. If not done in a proper way, it may lead to cancer and diabetic retinopathy. *S. boulardii* is known for protecting the host body against inflammation and injury by decreasing visceral hypersensitivity and modifying inflammatory cytokine profile.

Probiotics for respiratory diseases

Bronchitis, sinusitis, pharyngitis, rhinosinusitis, otitis is some of the most common respiratory disorders. Probiotics exhibit both anti-inflammatory and anti-microbial properties owing to which they can be used for the prevention of a number of respiratory disorders. For example: for controlling episodes of pneumonia in patients with cystic fibrosis, *Lactobacillus rhamnosus* can be administered. *Lactobacillus fermentum*, *L. casei*, and *Bifidobacterium longum* are some of the common probiotics used for the treatment of respiratory issues.

Probiotics for cardiovascular diseases

Probiotics Angiotensin-Converting Enzyme (ACE) is a key enzyme behind hypertension. *Lactobacillus helvetics and Saccharomyces cerevisiae* are known to synthesize peptides that can inhibit the activity of ACE.

Probiotics for inflammatory diseases

can be used for the treatment of Ulcerative colitis and Chrohn's disease. They result in inflammation of GIT, both aerobic and anaerobic bacteria are responsible. These two diseases in combination are known as inflammatory bowel disease. *Lactobacillus*, *Enterobacter*, and *Bifidobacillus* are used for the treatment of inflammation.

Advantages of probiotics

- **Digestive Health**: Helps with diarrhea, constipation, bloating, and overall gut balance by fostering good bacteria.
- **Immune Support**: Trains the immune system and supports a healthy microbiome, which is crucial for immune function.
- **Nutrient Absorption**: Aids in breaking down food and producing essential vitamins and nutrients.
- **Mental Health**: Emerging research suggests links to improved memory, anxiety, and depression.
- **Heart Health**: May help lower cholesterol levels.

Disadvantages of probiotics

- **Initial Side Effects**: May cause temporary gas, bloating, or stomach upset as your body adjusts.
- **Variability**: Not everyone responds the same way; effectiveness differs by strain and individual.

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- **Quality & Potency**: Supplements vary in quality, and some strains may not survive the digestive process.
- **Infection Risk (Rare)**: People with weakened immune systems, critical illnesses, or premature infants face a rare risk of infection.
- **Other Mild Reactions**: Headaches or allergic reactions can occur.

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.

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