S.Y.Bsc (paper 3 unit 1)

Lactobacillus, (genus *Lactobacillus*), any of a group of rod-shaped, gram-positive, non-spore-forming bacteria of the family Lactobacillaceae. *Lactobacillus* are characterized by their ability to produce lactic acid as a by-product of glucose metabolism.

The organisms are widely distributed in animal feeds, silage, manure, and milk and milk products.

Various species of *Lactobacillus* are used commercially during the production of milks, cheeses, and yogurt, and they have an important role in the manufacture of fermented vegetables (pickles), beverages (wine and juices), breads.

Lactobacillus are generally nonmotile and can survive in both aerobic and anaerobic environments.

it is 0.5 to 0.8 micrometre across by 2 to 9 μm long and occurs singly or in small chains.

Examples of other well-characterized *Lactobacillus* species include *L. acidophilus*,*L. brevis*, *L. casei*, and *L. sanfranciscensis*.

The amount of lactic acid produced by different *Lactobacillus* organisms varies. In several species, including *L. acidophilus*, *L. casei*, and *L. plantarum*, glucose metabolism is described as homofermentative, since lactic acid is the primary byproduct, representing at least 85 percent of end metabolic products. However, in other species, such as *L. brevis* and *L. fermentum*, glucose metabolism is heterofermentative, with lactic acid making up about 50 percent of metabolic byproducts and ethanol, acetic acid, andcarbon dioxide making up most of the other 50 percent.

Lactobacillus are commensal inhabitants of animal and human gastrointestinal tracts, as well as the human mouth and the vagina. Commercial preparations of lactobacilli are used as probiotics to restore normal flora after the imbalance created by antibiotictherapy.

The Normal Flora

In a healthy animal, the internal tissues, e.g. blood, brain, muscle, etc., are normally free of microorganisms. However, the surface tissues, i.e., skin and mucous membranes, are constantly in contact with environmental organisms and become readily colonized by various microbial species. The mixture of organisms regularly found at any anatomical site is referred to as the **normal flora**, except by researchers in the field who prefer the term "**indigenous microbiota**". The normal flora of humans consists of a few eucaryotic fungi and protists, but bacteria are the most numerous and obvious microbial components of the normal flora.

Gut flora, or **gut microbiota**, or **gastrointestinal microbiota**, is the complex community of microorganisms that live in the digestive tracts of humans and other animals, including insects. In humans, the gut flora is established at one to two years after birth, and by that time the intestinal epithelium and the intestinal mucosal barrier that it secretes have co-developed in a way that is tolerant to, and even supportive of, the gut flora and that also provides a barrier to pathogenic organisms.

Some human gut microorganisms benefit the host by fermenting dietary fiber into short-chain fatty acids (SCFAs), such as acetic acid andbutyric acid, which are then absorbed by the host.[3][6] Intestinal bacteria also play a role in synthesizing vitamin B and vitamin K as well as metabolizing bile acids, sterols, andxenobiotics.[2][6] The systemic importance of the SCFAs and other compounds they produce are like hormones and the gut flora itself appears to function like an endocrine organ,[6] and dysregulation of the gut flora has been correlated with a host of inflammatory and autoimmune conditions.

Stomach flora

Due to the high acidity of the stomach, most microorganisms cannot survive there. The main bacterial inhabitants of the stomach
include: *Streptococcus*, *Staphylococcus*, *Lactobacillus*,*Peptostreptococcus*, and types of yeast.[2]:720 *Helicobacter pylori* is a Gram-negative spiral organism that establishes on gastric mucosa causing chronic gastritis and peptic ulcer disease and is a carcinogen for gastric cancer

Intestinal flora

Gram-positive cocci and rod-shaped bacteria are the predominant microorganisms found in the small intestine.

Normal flora of stomach:

- Stomach receive large number of microorganism from mouth along with food and water but antimicrobial activity of HCl kills most of them. Few microorganisms that can tolerate acidity of stomach can form resident normal flora of stomach.

- Examples: *lactobacillus, Candida albicans, Helicobacter pylori, lactobacillus, Enterococc us* etc
- Number of microorganisms in stomach increases immediately after ingestion of food but number soon decreases after gastric juice is secreted.

Normal flora of small intestine:

- Duodenum is adjacent to stomach and hence it is slightly acidic in nature. Therefore microorganisms in duodenum is similar to that of stomach.
  Mainly *Lactobacillus* and*Enterococcus* are found in deuodenum.
- From duodenum ileum, intestine become less acidic and hence number of microorganism increases.
- In jejunum *Enterococci, lactobacillus,* Diphtheroid and *Candida albican*s are found.
- In Ileum microorganism begins to resemble to that of large intestine. Mainly obligate anaerobes such as *Clostridium perfinges,* Bacteroides and anaerobic E. coli are found.

Normal flora of large intestine:

- Large intestine is anaerobic in nature. It contains obligate anaerobes and facultative anaerobes.
- C*lostridium perfingens, Bifidobacterium, Bacteroides, Streptococcus fecalis, E. coli*

Role of Intestinal normal flora:

1. Synthesize vitamin B12 and vitamin K
2. Produces various carbohydrate metabolizing enzymesand helps in food digestion. Eg. Cellulase, glucosidase, galactosidase
3. Helps in steroid metabolism
4. Produces gases such as CH4 and CO2
5. Produces other substances such as Indole, Skatole, butyric acid etc

Probiotics are live bacteria and yeasts that are good for you, especially your digestive system. We usually think of these as germs that cause diseases. But your body is full of bacteria, both good and bad. Probiotics are often called "good" or "helpful" bacteria because they help keep your gut healthy. You may already be consuming some of these good bacteria if you eat fermented products, such as: yogurt, some cheeses, some pickled vegetables

Why are probiotics beneficial? Mix of bacteria is unique, like your fingerprint. Sometimes, illness or stress can change the bacterial balance and create digestive and other problems.

Probiotics work by changing the composition of your gut bacteria or the metabolic activity of existing bacteria. The good bacteria crowd out the bad in your intestine. This prevents the bad bacteria from multiplying and causing infection or inflammation. For example, too much yeast in the body can lead to yeast infection, but the well-balanced gut biome will keep yeast at lower levels.

Probiotics may help digestion and enable body to extract nutrients from your food. Good bacteria may also produce enzymes or proteins that inhibit, or even kill, harmful bacteria. Specific strains of probiotics also stimulate your immune system. Some bacteria are necessary for hormone production or vitamin (e.g., vitamin K) and nutrient absorption.

particular strains of probiotics may:

- aid digestion
- prevent diarrhea
- ease vaginal infections
- prevent autoimmune diseases
- ease skin ailments
- fend off urinary infections

But remember, not everyone responds in the same way to the same probiotic.

Common species of probiotics

The most commonly consumed probiotics are strains of two main species.

Bifidobacteria: This species of bacteria is commonly used in foods and supplements. They're thought to: support the immune system, limit the growth of harmful bacteria in the intestine help in breaking down lactose into nutrients the body can use.

Lactobacillus: This species of bacteria produces lactase, the enzyme that breaks down lactose, or milk sugar. These bacteria also produce lactic acid. Lactic acid helps control the population of bad bacteria. It also serves as muscle fuel and increases the body's absorption of minerals. *Lactobacillus* bacteria are found naturally in the: mouth,small intestine.

Nitrogen-fixing bacteria, microorganisms capable of transforming atmospheric nitrogen into fixed nitrogen.
Two kinds of nitrogen-fixing bacteria are recognized. The first kind, the free-living (nonsymbiotic) bacteria, includes the cyanobacteria (or blue-green algae) *Anabaena* and *Nostoc* and genera such as *Azotobacter* and *Clostridium*. The second kind comprises the mutualistic (symbiotic) bacteria; examples include *Rhizobium*, associated with leguminous plants (e.g., various members of the pea family); certain *Azospirillum* species, associated with cereal grasses.
The symbiotic nitrogen-fixing bacteria invade the root hairs of host plants, where they multiply and stimulate formation of root nodules, enlargements of plant cells and bacteria in intimate association. Within the nodules the bacteria convert free nitrogen to ammonia, which the host plant utilizes for its development.

1} Rhizobia are bacteria that fix nitrogen after becoming established inside root nodules of legumes.To express genes for nitrogen fixation, rhizobia require a plant host; they cannot independently fix nitrogen.[1] In general, they are Gram-negative, motile, non-sporulating rods. In a symbiotic relationship with the soil bacteria known as 'rhizobia', legumes form nodules on their roots (or stems, see figure below) to 'fix' nitrogen into a form usable by plants (and animals).. Rhizobia fix atmospheric nitrogen or N_2, into inorganic nitrogen compounds, such as ammonium, NH_4^+, which is then incorporated into amino acids, which can be utilized by the plant. Plants cannot fix nitrogen on their own, but need it in one form or another to make amino acids and proteins. Because legumes form nodules with rhizobia, they have high levels of nitrogen available to them. In return for the fixed nitrogen that they provide, the rhizobia are provided shelter inside of the plant's nodules and some of the carbon substrates and micronutrients that they need to generate energy and key metabolites for the cellular processes that sustain life.

2} Azotobacter is a genus of usually motile, oval or spherical bacteria that form thick-walled cysts and may produce large quantities of capsular slime. . A bacterium can be almost the same size as a**yeast** cell, which is a eucaryotic single-celled microorganism.
They are aerobic, free-living soil microbes which play an important role in the nitrogen cycle in nature, binding atmospheric nitrogen, which is inaccessible to plants, and releasing it in the form of ammonium ions into the soil (nitrogen fixation). There are six species of *Azotobacter*. The representative species is *Azotobacter vinelandii*. In addition to being a model organism for studying diazotrophs, it is used by humans for the production of biofertilizers, food additives, and some biopolymers.

Relative to other bacteria, *Azotobacter* is very largeA noteworthy feature of *Azotobacter* is the ability of the bacteria to "fix" atmospheric nitrogen, by the conversion of this elemental form to ammonia. Plants are able to utilize the ammonia as a nutrient. *Azotobacter* can accomplish nitrogen fixation by using three different **enzymes** , which are termed nitrogenases. The enzyme diversity, and an extremely rapid metabolic rate (the highest of any known living organism) allow the bacterium to fix nitrogen when oxygen is present. The other nitrogen-fixing bacteria possess only a single species of nitrogenase, which needs near oxygen-free conditions in order to function. The enhanced versatility of *Azotobacter* makes the microbe attractive for agricultural purposes.

Soilborne illnesses and diseases are caused by numerous microorganisms and parasites that live in soils. Soil serves as an ecosystem for diverse microbes that perform various roles and that range from useful organisms in biological and geological processes to dangerous transmitters of diseases.

Clostridium tetani is a common soil bacterium and the causative agent of tetanus. Tetanus, also called lockjaw. This bacterium produces a toxin that affects the brain and nervous system, leading to stiffness in the muscles. If *Clostridium tetani* spores are deposited in a wound, the neurotoxin interferes with nerves that control muscle movement. *C. tetani* usually enters the body through a wound. In the presence of anaerobic (low oxygen) conditions, the spores germinate. Toxins are produced and disseminated via blood and lymphatics. Toxins act at several sites within the central nervous system, including peripheral motor end plates, spinal cord, and brain, and in the sympathetic nervous system.

C. tetani is a rod-shaped Gram-positive bacterium, typically up to 0.5 micrometers wide and 2.5 micrometers long.
It is motile by way of various flagellae that surround its body.
C. tetani is an anaerobe and cannot survive in the presence of oxygen.It grows best at temperatures ranging from 33°C to 37°C.
C. tetani spores are extremely hardy and are resistant to heat and various antiseptics. The spores are long-lived and are distributed worldwide in soils as well as in the intestines of various livestock and companion animals.

The infection can cause severe muscle spasms, serious breathing difficulties, and can ultimately be fatal. Although tetanus treatment exists, it is not uniformly effective. The best way to protect against tetanus is to take the vaccine.

Foodborne illness results from eating food contaminated with bacteria (or their toxins) or other pathogens such as parasites or viruses. The illnesses range from upset stomach to more serious symptoms, including diarrhea, fever, vomiting, abdominal cramps, and dehydration.

Foodborne botulism

clostridium botulinum is a Gram-positive, spore-forming, obligate, motile, rod shaped bacterium.

C. botulinum is an anaerobic bacterium, meaning it can only grow in the absence of oxygen. Foodborne botulism occurs when *C. botulinum* grows and produces toxins in food prior to

consumption. *C. botulinum* produces spores and they exist widely in the environment including soil, river and sea water.

The growth of the bacteria and the formation of toxin occur in products with low oxygen content. This happens most often in lightly preserved foods and in inadequately processed, home-canned or home-bottled foods.

The botulinum toxin has been found in a variety of foods, including low-acid preserved vegetables, such as green beans, spinach, mushrooms, and beets; fish, including canned tuna, fermented, salted and smoked fish; and meat products,.

a. Foodborne botulism is a serious, potentially fatal disease. However, it is relatively rare. It is an intoxication usually caused by ingestion of potent neurotoxins, the botulinum toxins, formed in contaminated foods. Person to person transmission of botulism does not occur.
b. Spores produced by the bacteria *Clostridium botulinum* are heat-resistant and exist widely in the environment, and in the absence of oxygen they germinate, grow and then excrete toxins. There are 7 distinct forms of botulinum toxin, types A–G. Four of these (types A, B, E and rarely F) cause human botulism. Types C, D and E cause illness in other mammals, birds and fish.
c. Botulinum toxins are ingested through improperly processed food in which the bacteria or the spores survive, then grow and produce the toxins. Though mainly a foodborne intoxication, human botulism can also be caused by intestinal infection with *C. botulinum*in infants, wound infections, and by inhalation.

The symptoms are not caused by the bacterium itself, but by the toxin produced by the bacterium. Symptoms usually appear within 12 to 36 hours (within a minimum and maximum range of 4 hours to 8 days) after exposure.

Botulinum toxins are neurotoxic and therefore affect the nervous system. Foodborne botulism is characterized by descending, flaccid paralysis that can cause respiratory failure. Vomiting, diarrhoea, constipation and abdominal swelling may also occur.

Waterborne diseases are caused by pathogenic microorganisms that most commonly are transmitted in contaminated fresh water. Infection commonly results during bathing, washing, drinking, in the preparation of food, or the consumption of food thus infected. Microorganisms causing diseases that characteristically are waterborne prominently include protozoa and bacteria, many of which are intestinal parasites, or invade the tissues or

circulatory system through walls of the digestive tract. Various other waterborne diseases are caused by viruses.

Salmonella infection (salmonellosis) is a common bacterial disease that affects the intestinal tract. Salmonella bacteria typically live in animal and human intestines and are shed through feces. Humans become infected most frequently through contaminated water or food. *Salmonella* infections cause diseases in humans (for example, salmonellosis, gastroenteritis, typhoid fever, and paratyphoid fever), animals, and birds. *Salmonella* are a group of closely related rod-shaped, Gram-stained negative (Gram-negative or G-) bacteria that have flagella (tail-like structures used for movement).

The nomenclature of specific types of *Salmonella* a member of the *Enterobacteriaceae* Typically, people with salmonella infection have no symptoms. Others develop diarrhea, fever and abdominal cramps within eight to 72 hours. Most healthy people recover within a few days without specific treatment.

Typhoid and paratyphoid fevers are commonly grouped together under the collective term 'enteric fever'. Typhoid is caused by *Salmonella typhi* (strictly termed*S. enterica* sub-species *enterica serotype typhi*) and paratyphoid is caused by either *Salmonella paratyphi A, B,* or *C.* Typhoid and paratyphoid are transmitted mainly by the fecal-oral route. In most cases an asymptomatic carrier of *S. typhi*, or an individual who has recently recovered from the infection, continues to excrete large numbers of organisms in the stool and contaminates food or water, either through direct food handling, through transfer of bacteria by flies and other insects, or by contamination of potable water

Transmission

Salmonella Typhi is spread through the fecal-oral route from individuals that are currently infected and from asymptomatic carriers of the bacteria. Unlike other strains of *Salmonella*, there are no animal carriers of *S.* Typhi. Humans are the only known carriers of the bacteria. An asymptomatic human carrier is an individual who is still excreting *S.* Typhi in their stool a year after the acute stage of the infection. Human carriers are responsible for the transmission of the bacteria in endemic regions of the world.

Often there is a gradual onset of a high fever over several days,weakness, abdominal pain, constipation, and headaches also commonly occur. Diarrhea is uncommon and vomiting is not usually severe. Some people develop a skin rash with rose colored spots. In severe cases there may be confusion. Without treatment, symptoms may last weeks or months. Other people may carry the bacterium without being affected; however, they are still able to spread the disease to others