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SUBJECT: **Basic Microbiology**
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Q1: Fill in the Blanks.

- 1) **Probiotics** are live bacteria and yeasts that are good for and have beneficial effects on the host by improving its intestinal microbial balance.
 - 2) Foods containing the combination of probiotics and prebiotics are referred to as **Synbiotic**
 - 3) When a chemical substance inhibits bacterial growth and proliferation is known as **Bacteriostatic**
 - 4) Microbes that are always present are called **Normal flora**.
 - 5) The symbiotic relation in which one organism benefits, the other is neither helped nor harmed is known as **Mutualism**
 - 6) **Conjugation** is the direct transfer of DNA from one bacterium to another.
 - 7) A genetic structure in a cell that can replicate independently of the chromosomes is known as **cytoplasm of a bacterium**.
 - 8) The population of microorganisms that live on the skin and mucous membranes of health normal person from birth until death is called **Normal flora**
 - 9) The expression of a gene into a protein occurs by **Messenger RNA** and **RNA Polymerase**.
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Q2: What is normal flora, advantages and disadvantages of normal flora?

ANS;;

Normal flora are the microorganisms that live on another living organism (human or animal) or inanimate object without causing disease. The human body is not sterile; we become colonised by bacteria from the moment we are born. We are covered with, and contain within our intestines, approximately one hundred trillion bacteria that form the normal flora of our bodies. This normal flora helps to prevent us becoming colonised with more dangerous bacteria, which might lead to infection.

Advantages;;

- ❖ The **normal flora** prevent colonization by pathogens by competing for attachment sites or for essential nutrients.
- ❖ This is thought to be their most important beneficial effect, which has been demonstrated in the oral cavity, the intestine, the skin, and the vaginal epithelium.

- ❖ Some synthesize vitamins that are absorbed as nutrients by the host (e.g. K & B12).
- ❖ Some produce substances that inhibit pathogenic species.
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- ❖ They stimulate the development of certain tissues, e.g. colon and lymphatic tissues in gastrointestinal tract.
- ❖ They stimulate production of cross-reactive antibodies. Since the normal flora behave as antigens in an animal, they induce low levels of antibodies that cross react with similar antigens on pathogens, preventing infection or invasion

Disadvantages;;

- ❖ The **normal flora** may antagonize other bacteria through the production of substances which inhibit or kill nonindigenous species. 19.
- ❖ Importance of The **Normal Flora (Disadvantages)**
- ❖ They can cause disease in the following:
 - ❖ When individuals become immunocompromised.
 - ❖ They prevent or suppress the entry of the pathogens.
 - ❖ Colonies produced by some organisms of normal flora have a harmful effect on the pathogens.
 - ❖ Endotoxins liberated by normal flora may help the defense mechanism of the body.

Q3: Write in detail different stages of Pathogenesis.

Ans

Pathogenesis

The pathogenesis of a disease is the biological mechanism (or mechanisms) that leads to a diseased state. The term can also describe the origin and development of the disease, and whether it is acute, chronic, or recurrent.

Stages of Pathogenesis

- ❖ Pathogenesis is the method by which a disease can develop.
- ❖ This can occur through foodborne intoxication where the causative agent produces toxins in the body (e.g., botulism).
- ❖ Another route is the colonization of an invading pathogen on the host surface,(e.g., *Vibrio* and *Corynebacterium*).
- ❖ Pathogenesis can also occur by pathogens invading and breaching the body's barrier in order to multiply. (e.g., tuberculosis and plague).
- ❖ The relationship between a host and pathogen is dynamic.
- ❖ Production of disease occurs through a process of steps.
- ❖ The first five mechanisms make up a pathogen's invasiveness (i.e., ability to invade tissues).

1. Transmission

- In order to begin infection and eventually cause disease, pathogens must find a transmission route.
- Transmission of an infectious agent can occur in many ways, but it is typically through exposed skin (e.g., a cut, abrasion, puncture, or wound) or mucous membranes (e.g., gastrointestinal tract, respiratory tract, or urogenital tract).

2. Adherence

- Once the pathogen has gained access to the body, it must have some means of attaching itself to the host's tissues.
- This attachment is called adherence and is a necessary step in pathogenicity.
- Microbes contain ligands, which are projections that attach host receptors or surface proteins.
- If a microorganism cannot adhere to a host cell membrane, disease will not occur.

3. Invasion

- At this point, microbes begin to invade the host and produce a bacteremia (i.e., presence of bacteria in the bloodstream) or viremia (presence of a virus in the bloodstream).

- Some bacteria are able to cause disease while remaining on the epithelial barriers, while many need to penetrate that barrier.
- Once this barrier has been penetrated, these pathogens can multiply without competition.

4. Colonization

- Colonization is the multiplication of pathogenic organisms where toxins are produced and the normal flora are overcome.
- During this stage, pathogens compete with normal flora for space and nutrients.
- Pathogens usually colonize host tissues that are in contact with the external environment.

5. Evasion of Host Defenses

- After colonization, pathogens circumvent the host's innate & adapted defenses by phagocytosis.
- Multiple mechanisms are used by pathogens to evade a host's immune system.
- Pathogens must also avoid adapted defenses.
- They can also utilize antigenic variation to alter the antigen structure.
- In addition, pathogens can mimic host molecules, which can cause disease-related damage.

6. Cause Damage or Disease to Host

- Damage can occur through direct or indirect pathways.
- Direct methods produce toxins, which are poisonous substances that produce toxemia within a host.
- Three types of toxins are produced to cause damage:
 - **Exotoxins:** Proteins secreted by pathogens that cause damage to the host (botulinum toxin, tetanus toxin).
 - **Endotoxins:** Toxic substances that are released when a cell is killed (Lipopolysaccharides).
 - **Exoenzymes:** Enzymes that function outside the host cells or tissues.

7. Exiting the Host

- A pathogen must exit the body.
- This occurs through various routes.
- Examples include sneezing, coughing, diarrhea, coitus, pus, blood, or insect bites.

8. Survival Outside the Host

- Finally, a pathogen must be able to survive in the environment long enough to be transmitted to another host.
 - Some are hardy and can survive for several weeks before a new host is found.
 - There are others that survive in animal reservoirs or require direct contact because they are fragile.
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Q4: How the Gene Transfer for one bacterium to another.

ANS;;

Normally, genes and the characteristics they code for are passed down from parent to progeny. This is called vertical gene transfer and is why you have half of the characteristics of your mother, and half of your father. Bacteria and some lower eukaryotes are unique in that they can pass DNA from one cell of the same generation to another. We refer to this as **Horizontal Gene Transfer**.

There are three ways for bacteria to transfer their DNA horizontally:

1) Transformation

- uptake and retention of external DNA molecules

2) Conjugation

- direct transfer of DNA from one bacterium to another

3) Transduction

- the transfer of DNA between bacteria by a virus

Transformation

- Under the right conditions, bacteria can “take in” external DNA fragments (or plasmids) by transformation.
- DNA binding proteins transfer external DNA across cell envelope
- homologous recombination can then occur
- bacterial cells capable of transformation are referred to as competent

Conjugation

Requires an F factor plasmid

- has all “conjugation genes”
- directs formation of a sex pilus
- single DNA strand produced by DNA replication is transferred to F- cell through the sex pilus, recipient produces 2nd strand

Transduction

- A virus (phage) particle can transfer DNA fragments from one host cell to another followed by recombination
 - requires a virus to be packaged with bacterial DNA “by mistake”
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Q5: Write short notes on the following:

1. Symbiotic relationship

Symbiotic relationships. Symbiosis is a close relationship between two species in which at least one species benefits. For the other species, the relationship may be positive, negative, or neutral. There are three basic types of symbiosis: mutualism, commensalism, and parasitism.

2. Antimicrobial drug

Antimicrobial drug: A drug used to treat a microbial infection. "Antimicrobial" is a general term that refers to a group of drugs that includes antibiotics, antifungals, antiprotozoals, and antivirals.

3. Antimicrobial resistance

Antimicrobial resistance is the ability of microbes to resist the effects of drugs in same dosage. When the drug loses the ability to either kill or inhibit the growth of microbes

and the microbes gain the ability to survive in the presence of drug to which they were previously susceptible this is called resistance.

4. Probiotics

Probiotics are often called "good" or "helpful" bacteria because they help keep your gut healthy. Probiotics are live bacteria and yeasts that are good for and have beneficial effects on the host by improving its intestinal microbial balance.

Side effects;;

- Rare cases cause bloating, diarrhea, abdominal pain.
- If in excess cause infection that require medical attentions.
- People having on underlying disease or compromised immune system cause potential health problems like skin rash, fever, bloody stools etc.

5. Prebiotic

- Non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus improve host health”
- First identified in 1995
- Typically oligosaccharides:
- Found in: Breastmilk, chicory root, leeks, onions, garlic, asparagus, whole grains, beans, banana etc.
- It should increase the number and/or activity of **bifidobacteria and lactic acid bacteria**
- Traditional dietary sources of prebiotics include soybeans, inulin sources (such as Jerusalem artichoke, jicama, and chicory root), raw oats, unrefined wheat, and unrefined barley .

THANK YOU