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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 **sybiotics**.
3. When a chemical substance inhibits bacterial growth and proliferation is known as **bacteriostatic**.
4. Microbes that are always present are called **resident flora**.
5. The symbiotic relation in which one organism benefits, the other is neither helped nor harmed is known as **commensalism**.
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 **plasmid**.
8. The population of microorganisms that live on the skin and mucous membranes of health normal person from birth until death is called **microbial flora**.
9. The expression of a gene into a protein occurs by **transcription** and **translation**.

**Q2: What is normal flora, advantages and disadvantages of normal flora?**

**Answer: Normal Flora:**

**• Definition**

Normal flora is the mixture of microorganisms (bacteria and fungi) that are regularly found at any anatomical site of human body on /within the body of a healthy person.

**ORIGIN OF NORMAL FLORA**

* Healthy fetus, in utero, is essentially free of MOs
* Infant exposed immediately to MOs when passing through mom’s vaginal tract and then to MOs in environment
* Within few hours, oral and nasopharyngeal flora of neonate established
* Within one day, resident flora of lower intestinal tract established

**TYPES OF NORMAL FLORA**

**• 1. Resident Flora**

• Microbes that are always present

• consists of relatively fixed types of microorganisms regularly found in a given

 area at a given age

• If disturbed, it promptly reestablishes itself

**• 2. Transient Flora**

• Microbes that live in or on your body for a period of time (hours, days, weeks,

 months) then move on or die off

• consists of nonpathogenic or potentially pathogenic microorganisms that

 inhabit the skin or mucous membranes for hours, or days

**Advantages of the normal flora:**

**1.** **Protection from External Environment**

Because of the normal flora occupy body’s epithelial surfaces, they are able to prevent other bacteria from establishing themselves by blocking receptors (attachment), competing for essential nutrients or producing antibacterial substances.

e.g. Fatty acids, peroxides, Bacteriocins

**2. NUTRITION**

•They produce vitamin B12 and vitamin K in intestine.

E. coli & Bacteroids produce Vitamin K in the gut which is available for use by host.

**3. IMMUNOSTIMULATION**

a) They produce antibodies which may contribute to host defenses.

b) Some of these antibodies may cross react with normal tissue components.

**4. Inhibitory action**

The normal bacteria flora exerts microbial antagonism against nonindigenous species by production of inhibitory fatty acids, peroxides, bacteriocins, etc.

**Disadvantages of the normal flora:**

1. They can cause disease in the following:

a) When individuals become immunocompromised

b) When they change their usual anatomic location.

2. The oral flora of humans may harm their host since some of these bacteria are

 pathogens or opportunistic pathogens.

**Q3: Write in detail different stages of Pathogenesis.**

**Answer:**

The pathogenesis of a [disease](https://en.wikipedia.org/wiki/Disease) is the [biological mechanism](https://en.wikipedia.org/wiki/Mechanism_%28biology%29) (or mechanisms) that lead to a diseased state. The term can also describe the origin and development of the disease, and whether it is [acute](https://en.wikipedia.org/wiki/Acute_%28medical%29), [chronic](https://en.wikipedia.org/wiki/Chronic_%28medical%29), or [recurrent](https://en.wikipedia.org/wiki/Relapse). The word comes from the [Greek](https://en.wikipedia.org/wiki/Ancient_Greek) *pathos* ("suffering", "disease") and *genesis* ("creation")

**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 (Lipolysaccharides).
* **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.

**Q4: How the Gene Transfer for one bacterium to another.**

**Answer: Conjugation:**

* Direct transfer of DNA from one bacterium to another.

**Bacterial Conjugation**

Conjugation is the process by which one bacterium transfers genetic material to another through direct contact. During conjugation, one bacterium serves as the donor of the genetic material, and the other serves as the recipient. The donor bacterium carries a DNA sequence called the fertility factor, or F-factor. The F-factor allows the donor to produce a thin, tubelike structure called a pilus, which the donor uses to contact the recipient. The pilus then draws the two bacteria together, at which time the donor bacterium transfers genetic material to the recipient bacterium. Typically, the genetic material is in the form of a plasmid, or a small, circular piece of DNA. The genetic material transferred during conjugation often provides the recipient bacterium with some sort of genetic advantage. For instance, in many cases, conjugation serves to transfer plasmids that carry antibiotic resistance genes.

**Q5: Write short notes on the following:**

1. Symbiotic relationship
2. Antimicrobial drug
3. Antimicrobial resistance
4. Probiotics
5. Prebiotic

**Answer:**

1. **Symbiotic relationship:**

Symbiosis refers to relationships between organisms of different species that show an intimate association with each other.

Symbiotic relationships provide at least one of the participating species with a nutritional advantage.

3 types of symbiosis have been recognized depending on the nature of the relationship:

* Parasitism
* Commensalism
* Mutualism
1. **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.

**Definitions:**

* **Chemotherapy:** It means using chemical agents that are selectively toxic to the causative agent of the disease, such as a microorganism or malignant cells.
* **Antimicrobial drugs:** Drugs that are used to treat infections with micro-organisms are known as antimicrobial drugs.
* **Antibiotics:** Antibiotics are chemical substances produced from various microorganisms (bacteria and fungi) that kill or inhibit the growth of other microorganisms.
* **Bacteriostatic:** when a chemical substance inhibit bacterial growth and proliferation
* **Bactericidal:** when a chemical substance kill bacteria
* **Antibiotic resistance:** Antibiotic resistance is the ability of bacteria/fungi to resist the effects of an antibiotic.
* **Narrow spectrum:** Drugs which are effective against limited number of microbes: Example: Polymyxin, Isoniazid,
* **Broad-spectrum:** Drugs which kill wide range of microorganisms
1. **Antimicrobial resistance:**

Antimicrobial resistance is the ability of microbes to resist the effects of drugs in same dosage. When the drug loose 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.

**Intrinsic resistance**

Intrinsic resistance is the innate ability of a bacterial species to resist activity of a particular antimicrobial. This can also be called “insensitivity”

* **Lack of affinity of the drug for the bacterial target**

 For example penicillin's are not effective against mycobacterium TB, as

 the later does not contain peptidoglycan in cell wall.

* **Inaccessibility of the drug into the bacterial cell**

For example: gram –ve bacteria are naturally resistant to vancomycin and penicillin G/V. Because of inability to penetrate outer membrane.

**Acquired resistance**

* Acquired resistance means when the microbes gains the ability to grow in the presence of a drug.
* Acquired resistance develops when micro-organisms (bacteria, fungus, parasites or viruses) no longer respond to a drug to which they were previously susceptible.
* Each year in the United States, at least 2 million people become infected with bacteria that are resistant to antibiotics and at least 23,000 people die each year as a direct result of these infections.
1. **Probiotics:**

[Probiotics](https://www.webmd.com/diet/features/answers-to-your-questions-about-probiotics) are live bacteria and yeasts that are good for you, especially your [digestive system](https://www.webmd.com/heartburn-gerd/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 can find probiotics in supplements and some foods, like yogurt. Doctors often suggest them to help with digestive problems.

**Types of Probiotics**

Many types of bacteria are classified as probiotics. They all have different benefits, but most come from two groups. Ask your doctor about which might best help you.

**Lactobacillus.** This may be the most common probiotic. It's the one you'll find in yogurt and other fermented foods. Different strains can help with [diarrhea](https://www.webmd.com/digestive-disorders/digestive-diseases-diarrhea) and may help people who can't digest lactose, the sugar in milk.

**Bifidobacterium.** You can find it in some dairy products. It may help ease the symptoms of [irritable bowel syndrome](https://www.webmd.com/ibs/default.htm) ([IBS](https://www.webmd.com/ibs/video/drossman-what-is-ibs)) and some other conditions.

Saccharomyces boulardii is a yeast found in probiotics. It appears to help fight diarrhea and other digestive problems.

1. **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:

Breast milk, 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, insulin sources (such as Jerusalem artichoke, jicama, and chicory root), raw oats, unrefined wheat, and unrefined barley.