

Post Diploma Graduate (PDG) Course in Human Nutrition and Dietetics in NAIROBI-KENYA School of online and distance learning

Student’s Name in Full: Awu Daniel Malish

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ASSIGNMENT 6

1. State the main difference between bacteria cell and typical prokaryotic cells.

Bacteria are relatively simple, prokaryotic organisms whose cells lack a nucleus or nuclear membrane. The bacteria may appear in three forms, namely; as rods (bacilli), spheres (cocci), or spirals (spirilla, spirochetes or vibrios). Bacteria reproduce by binary fission, have unique constituents in their cell walls, and exist in most environments. Cocci bacteria can exist singly, in pairs (as diplococci), in groups of four (as tetrads), in chains

(as streptococci), in clusters (as stapylococci), or in cubes consisting of eight cells (as sarcinae.) , bacilli (or bacillus for a single cell) are rod-shaped bacteria in

pairs, or in chains (streptobacillus). Spirilla (or spirillum for a single cell) are curved bacteria which can range from a gently curved shape to a corkscrew-like spiral.

Structurally, the bacteria cell has the following in comparison with the typical prokaryotic cells.

1. Flagella: Flagella are whip-like structures protruding from the bacterial cell wall and are responsible for bacterial motility (i.e. movement). A bacterial cell may have one to many flagella. The flagella are entirely composed of a protein called flagellin. Common forms include; peritrichous - Multiple flagella found at several locations about the cell, Polar - Single flagellum found at one of the cell poles , lophotrichous - A tuft of flagella found at one cell pole.
2. Pili (or Fimbriae): Pili are found from some bacteria and are used for attachments to surfaces such as tissues. Many pathogens possess pili, which are composed of the protein pilin. Certain pili, known as conjugation/sex pili, unite bacterial cells to one another and permit the passage of DNA between the cells.
3. Glycocalyx (Capsule and Slime Layers): Glycocalyx is used to enclose bacteria especially the pathogenic ones. Glycocalyx is composed of a thick, gummy material, serves as a

reservoir for nutrients and protects the organism from changes in the environment, because of its high water content. When the Glycocalyx is a tightly bound structure, it is known as a capsule but when it is a poorly bound structure that flows easily, it is known as a slime layer.

1. Cell wall: The cell wall gives shape to the cell and protection to the bacterium. It prevents the cell from swelling and bursting due to osmotic changes. It is composed of a polysaccharide called murein or peptidoglycan which is cross linked with short amino acid

Chains.

1. Cytoplasmic membrane: It is a thin, elastic, selectively permeable membrane found internal to the cell wall. It helps in transporting nutrients into the cell and waste products out of the cell. It is composed of phospholipids, proteins and polysaccharides. The bacterial cytoplasmic membrane is composed of a phospholipid bilayer and thus has all of the general functions of a cell membrane such as acting as a permeability barrier for most molecules and serving as the location for the transport of molecules into the cell. Bacteria have a wide variety of fatty acids within their membranes such as saturated and unsaturated fatty acids helping to maintain optimum fluidity of the membrane.
2. Cytoplasm: It is a semi-fluid ground substance enclosed by the plasma membrane. It appears granular due to the presence of large number ribosomes. The ribosomes may occur singly or in clusters called polyribosomes. In most bacteria the most numerous intracellular structure is the ribosome, the site of protein synthesis in all living organisms.
3. Endospores: Some bacteria have the ability to form resting cells known as endospores. The location of an endospore within a cell is species-specific and can be used to determine the identity of a bacterium. The spore forms in times of environmental stress, such as lack of nutrients and moisture needed for growth, and thus is a survival strategy.
4. State the functions of the Cytoplasmic membrane in a bacterial cell.

The bacterial cytoplasmic membrane is a fluid phospholipid bilayer that encloses the bacterial cytoplasm. The cytoplasmic membrane is semipermeable and determines what molecules enter and leave the bacterial cell. Passive diffusion is the net movement of gases or small uncharged polar molecules such as water across a membrane from an area of higher concentration to an area of lower concentration. The following are the functions of the cytoplasm membrane in the bacterial cell:

The cytoplasmic membrane is a selectively permeable membrane that determines what goes in and out of the organism. All cells must take in and retain all the various chemicals needed for metabolism. Water, dissolved gases such as carbon dioxide and oxygen, and lipid-soluble molecules simply diffuse across the phospholipid bilayer. Water-soluble ions generally pass through small pores - less than 0.8 nm in diameter - in the membrane . All other molecules require carrier molecules to transport them through the membrane. Materials move across the bacterial cytoplasmic membrane by passive diffusion, facilitated diffusion, and active transport.

-Passive diffusion: Passive diffusion is the net movement of gases or small uncharged polar molecules across a phospholipid bilayer membrane from an area of higher concentration to an area of lower concentration. Examples of gases that cross membranes by passive diffusion include N2, O2, and CO2; examples of small polar molecules include ethanol, H2O, and urea.

-Facilitated diffusion: Facilitated diffusion is the transport of substances across a membrane by transport proteins, such as uniporters and channel proteins, along a concentration gradient from an area of higher concentration to lower concentration. Facilitated diffusion is powered by the potential energy of a concentration gradient and does not require the expenditure of metabolic energy.

-Active transport: Active transport is a process whereby the cell uses both transport proteins and metabolic energy to transport substances across the membrane against the concentration gradient. In this way, active transport allows cells to accumulate needed substances even when the concentration is lower outside. Active transport enables bacteria to successfully compete with other organisms for limited nutrients in their natural habitat, and enables pathogens to compete with the body's own cells and normal flora bacteria for the same nutrients.

Functions of the cytoplasmic membrane other than selective permeability include;

1. Energy production. The electron transport system for bacteria with aerobic and anaerobic respiration, as well as photosynthesis for bacteria converting light energy into chemical energy is located in the cytoplasmic membrane.
2. Motility. The motor that drives rotation of bacterial flagella is located in the cytoplasmic membrane.
3. Waste removal. Waste by products of metabolism within the bacterium must exit through the cytoplasmic membrane.
4. Formation of endospores
5. Name three members of enterobacteriacea. This group of micro-organisms are also known as the “hygiene” group of micro-organisms. Explain why.

Enterobacteriaceae are Gram-negative bacteria of a large family that includes Escherichia coli, Klebsiella, Salmonella, Shigella and Yersinia pestis. They can cause a range of illnesses from bacteremia and endocarditis, to infections of the respiratory tract, skin, soft-tissues, urinary tract, joints, bones, eyes and CNS.

Enterobacteriaceae are usually considered by food manufacturers as hygiene indicators and therefore used to monitor the effectiveness of implemented preventive pre-requisite measures such as Good Manufacturing Practices and Good Hygiene Practices (J-L. Cordier, 2006). Enterobacteriaceae are hardly ever identified as significant hazards in Hazard Analysis and Critical Control Point (HACCP) studies and thus no specific control measures are defined either. However, the specific control measures implemented to control recognized significant hazards such as Salmonella are suitable and effective as well to control members of this family. The characteristics of both the pathogen and the hygiene indicator are indeed very similar in terms, for example, of sensitivity to heat-treatments or other killing steps.

1. Define mycotoxins. Giving examples explain why they are of concern in the food industry.

Mycotoxins are dangerous toxins produced by molds mostly on cereals (corn, wheat, rice) and nuts such peanut, almonds, etc., (Module six on food microbiology), however they may be present in mold-infected produce such as grapes, apples, celery, lettuce, etc. Examples of most dangerous mycotoxins are the aflatoxins and carcinogenic chemical compounds produced by certain molds present in foods and feeds, especially in corn and peanuts. They are produced by molds such as Aspergillus flavus and Aspergillus flavus. Patulin in apples and ochratoxin A in cereals and fumonisin are other examples of mycotoxins.

Mycotoxins cause different degrees of toxicity according to exposure time, mycotoxin amount, physiological state, and sensitivity of the organism in humans and animals (Aycan .C and Elif O, 2019).

mycotoxins generate high level of economical loses for food industry due to reduced crop yields, lost trade revenues (local and international), and livestock illnesses.

The main effects of mycotoxins on national economies can be thought in five ways:

* Product yield losses due to toxigenic mold diseases
* Decrease in commercial value because of contaminated food and feed
* Human and animal health losses due to harmful impacts associated with mycotoxin-contaminated food and fodder consumption
* Cost of analysis of mycotoxin
* Strategies to control mycotoxin contamination

1. Explain why bacteriophages is a major concern in the dairy industry

A bacteriophage, also called a phage, is a virus that infects bacteria. These viruses are among the more complex viruses. Bacteriophages (or phages) have consistently played a significant role in the success of the dairy industry. Indeed, bacterial fermentation processes are threatened by contamination of raw milk with phages that infect lactic acid bacteria. This makes necessary the development of techniques to ensure control of the phage load in starting materials and equipment (Christopher C. Butler, 2017). In contrast, more recently, phages have been proposed as biocontrol agents to eliminate pathogenic or spoilage bacteria in dairy products. This review aims to summarize and discuss both the negative and positive impact of phages in dairy settings, depending on their specific bacterial hosts.

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