DIII / Hons - Zoology.
Paper - VII
Gr-A Medical biology. Lecture-5

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BACTERIA

Introduction :- Bacteria defined as microscopic single celled organisms that can penetrate into healthy tissues and start multiplying into vast numbers. These are unicellular free living small microorganisms which are visible under the light microscope. They occur in water, soil, air & all natural environments. They belong to kingdom Prokaryotae (Monera)

History :- Leuwenhoek 1683 for the first time described and figured bacteria, but the study of bacteria came much later in the early 19th Century. Cohn (1872) proposed the name bacteria.

Structure :- Bacteria are small microscopic organisms & are the simplest of Prokaryotes. The size & shape vary between the dimensions of .175 to 4.0 µm. Their form ranges from spherical cocci to rod shaped bacilli & to spiral shaped spirillae. A bacterial cell possess a distinct cell wall, surface appendages flagella, Pili, surface adherent capsule & slime layers, cytoplasmic membrane & cytoplasmic organelles.

(1) **Cell Wall** - A distinct cell wall beneath the capsule or on the surface (in non capsulated form). Cell wall is a rigid structure that provide shape to the organism. Cell wall consist of proteins, Polysaccharides & lipids. Carbohydrate component called lipopolysachande is unique in the cell wall Bacterial cell wall is 15-20 M in thickness & chemically inert. Chemical composition of cell wall is esp specific. Gram-negative bacteria have walls with higher lipid content and a greater variety of amino acids than Gram-positive bacteria.

(2) **Flagella and Pili :-** Flagellae are long slender, Thin hair like structure. Flagella attached with cytoplasm. They play important role in bacteria for motility. They have 0.01 to 0.02 µm in diameter. They have 3 to 20 µm in lenght.

Flagella found in both Gram positive & negative bacteria. Few coccal forms, most bacilli & almost all of the spiralla & vibrios are motile by flagella. They can be seen by compound microscope with special staining technique & can be seen easily under Electron microscope & dark filled microscope. Flagella have three parts: basal body, hook & filament.

Pili or Fimbriae are similar structure like flagella but not involved in motility. It is shorter than flagella - 3 µm. Fimbriae can be distributed over the entire surface of the cell. Fimbriae act as adherins & allow to microorganisms to attach to surface. They are responsible for cell clumping & haemagglutination in bacteria.

Pili are present in small in numbers compatibly fimbriae. Pili is joins to the bacterial cell for transfer of DNA from one cell to another cell. So Pili also called as Sex Pili or fertility Pili.

(3) Capsule & Slime layer :- Many bacteria secretes EPS extracellular Polysaccharides that are associated with the exterior of the bacterial cell. The EPS contains 2% Carbohydrate & 98% water, so they produce gummy or slimy exterior to the cell. Morphologically 2 external forms exist

(1) Capsule.
(2) Slime.

Capsule forms rigid, tightly & closely associated with cell. Slimes which are loosely associated with cell.

Functions of capsule & Slime :- (1) They protect from desiccation.

(2) They provide a protection barrier against the penetration of biocides.
(3) They protect against engulfment by phagocytes & Protozoa.
(4) They may promote the stability of bacterial suspension by preventing the cells from aggregation & settling.
(5) They may promote attachment of bacteria to surface.

(4) Cytoplasmic Membrane :— It is thin near about 5 to 10 nm. Biochemically, the cytoplasmic membrane is fragile, Phospho-lipid bilayer with proteins distributed randomly throughout. In the phospholipid bilayer most of the proteins are tenaciously held & called integral proteins. other Proteins are loosely attached those are called Peripheral proteins. The Phospholipid molecules are arranged in 2 parreled rows called Phospholipid bilayer. Each Phospholipid mole. contains a Polar head & tail. Polar head composed of a Phosphati group & glycerol. The non-Polar tails are interior of the bilayer. Prokaryotic Plasma membrane are less rigid than eukaryotic due to lack of sterols.

Functions of cytoplasmic Membrane :— (1) They including in transportation of nutients.
(2) It provides mechanical Strength to the bacterial cell.
(3) It helps in DNA replication.
(4) It contains the enzymes involved in the biosynthesis of membrane lipid & various macromolecules of the bacterial cell wall.

(5) Cytoplasm :— Bacterial cytoplasm is a type of suspension in that contains organic, inorganic solute in a viscous water. It contains the nucleus, ribosomes proteins and other water soluble components and reserve materials. The cytoplasm of bacteria differ from that of higher eukaryotic microorganisms in not containing endoplasmic reticulum, golgi apparatus, mitochondria and lysisomes. In most of the bacteria also contains extrachromosomal DAA (i.e. DNA are not connected to chromosomes) is also present.

(a) Ribosomes :— Ribosomes are most important structure in bacterial cytoplasm. They involved in protein synthesis. Ribosomes numbers varies with rate of protein synthesis. If greater the number of ribosomes then the greater the protein synthesis. They have 200 A° in diameter. They are characterized by their sedimentation properties. These bacterial ribosomes are called 70s ribosomes.

(b) Mesosomes :— In most of the bacteria particularly in Gram-positive bacteria the growth condition depending upon the membrane appears to be infolded at more than one point. Such infoldings are called Mesosomes. Mesosomes present in 2 types : In central (Septal) mesosome & Peripheral (lateral) mesosomes. Central mesosomes present deep into the cytoplasm & locate near the middle of the cell. These are involved in the DNA segregation & in the formation of cross walls during cell division. The peripheral mesosomes are not associated with nuclear material. Mesosomes are also called as chandroids and are visible only under electron microscope. Large No. of mesosomes have a higher respiratory activity e.g. Azotobacter.

(c) Nucleus :— Nucleus appears oval or elongated bodies & generally present one/cell. The genome consists of a single mole. of double stranded DNA arranged in a circle. It may open under certain conditions to form a long chain about 1000 μm in length. Bacterial nucleus does not have nuclear membrane, nucleolus & deoxyribonucleoprotein. The bacterial chromosome is haploid & replicated by simple fission instead of mitosis as in an eukaryotic cell.

(d) Spores :— Many bacterial spp. produce spores inside the cell and outside the cell. Inner spores are called endospores and outside the spores are called exospores E.g. Bacillus Anthracis, Bacillus subtilis etc. spores are extremly resistant to desiccation, staining, radiation, disinfecting chemicals and heat. Each bacterial spore on germination forms a single vegetative cell. They remain viable for long time & help bacteria to survive for long period under unfavourable condition.

(e) Endospores are thick walled, highly refractile bodies that are produced one/cell.