Morphology and Anatomy Of Bacteria Lec. 3 M.Sc. Shahalaa Ali MAIN TOPICS At the end of the Lecture , the students will be able to understand: 1- Classification of bacteria depending on their morphology and Gram staining property. 2- Anatomy of Bacterial Cell. 3- Various Bacterial cell appendages and their functions. Classification of bacteria depending on their morphology and Gram staining property. Most clinically relevant bacterial species range in size from 0.25 to 1 um in width and to 3 um in length , Thus requiring microscopy for visualization. Just as bacterial species and genera vary in their metabolic processes , their cells also vary in size , morphology and cell – to –cell arrangements and chemical composition and structure of the cell wall. Bacterial cell wall differences provide the basis for the Gram stain , a fundamental staining technique used in bacterial identification schemes. This staining procedure separates almost all medically relevant bacteria into two general types: 1- gram –positive bacteria (deep blue or purple) 2- gram – negative bacteria (pink to red) Shape of Bacteria .Cocci – arranged in group (clusters) , pair or chains . .Bacilli – arranged in chain , pair , and some bacilli are curved , comma shaped , or cuneiform shaped . Anatomy of Bacteria cell Structure of Bacterial Cell A- Cell Envelope 1- Cell Wall 2- Cell membrane (plasma membrane , Cytoplasmic membrane) B- Cytoplasm 1- Nucleoid 2- Ribosomes 3- Granules / Inclusion bodies 4- Mesosomes 5- Spores 6- Plasmids C- Appendages 1- Pilli 2- Flagella 3- Capsule Cell Wall Is a tough & rigid structure surrounding the bacterium like a shell . Weighs about 20-25 % of the dry weight of the cell . Functions : Accounts for shape of cell. Provides protection to the cell against osmotic damage . Confers rigidity upon bacteria . Takes part in cell division . Possesses target site for antibiotics , lysozymes and bacteriophages Carries bacterial antigens that are important in virulence and immunity . S . No. Character 1 Thickness 2 Periplasmic space 3 Lipids 4 Teichoic acid 5 Peptidoglycan Gram Positive Thicker Absent Absent or small Present 16-80nm Gram Negative Thinner Present Present Absent 2nm Gram Positive Cell Wall Peptidoglycan : thicker (16-80nm) than gram negative bacteria (2nm). Teichoic acid : 1- Contains in a significant amount which is absent in gram negative . 2- Constitute major surface Ags . 3- Two types (wall teichoic acid and lipoteichoic acid) . Gram Negative Cell Wall Gram negative cell wall components -Lipoprotein layer -Outer membrane complex structure with following -LPS (Lipopolysaccharide) : 1- constitutes endotoxin of GNB 2- Determine major surface Ag 3- Toxicity (pyrogenicity , lethal effect , tissue necrosis) -Periplasmic space -Peptidoglycan . Lipoprotein Layer: - Connects the peptidoglycan to outer membrane - . Outer membrane : - Contains certain proteins called as OMP (outer membrane protein) . - Target sites for phages , antibiotics and bacteriocins . - .Lipopolysaccharides (LPS) : - Consist of lipid A attached to a polysaccharide. -Constitutes the endotoxin of GNB . - . Periplasmic space : - Space between inner and outer membrane. - Contains various binding proteins for specific substrates. Peptidoglycan : Rigid part of cell wall peptidoglycan mucopeptide(murein) composed of N-acetyl muramic acid and N-acetyl glucosaminde alternating in chains ,cross linked by peptide subunits. Bacterial with Defective Cell Wall Synthesis of cell wall interfered or inhibited by many factors : _ Antibiotics _ Bacteriophage _ Lysozyme Cell membrane : Cytoplasmic Membrane . Is 5-10nm thick elastic semipermeable layer lies beneath for separating it from cell cytoplasm . . Acts as an osmotic barrier . . Acts as a semipermeable membrane controlling the inflow and outflow of metabolites to and from the protoplasm . . Contains enzymes

necessary for cell wall synthesis (cytochrome oxidase , enzymes of tricarboxylic acid) . Cytoplasm Is a colloidal system containing variety of organic and inorganic solutes in a viscous watery solution . Lacks: 1- Mitochondria 2- Endoplasmic reticulum Contains: 1- 70% water of bacterial mass. 2- Ribosomes . 3- Mesosomes 4- Vacuoles. 5- Inclusions Ribosomes Centre for protein synthesis. Are composed of 1- Ribosomal RNA (rRNA) 2-Ribosomal proteins. Intracytoplasmic inclusions 1- Source of stored energy 2- Are grow under conditions of nutritional deficiency and disappear when deficient nutrients are supplied . 3- Volutin or metachromatic granules are +nt in C. dipyheria. Nucleoid Bacteria don't have true nucleus and there is no nuclear membrane or nucleolus. Nucleiod is present irregularly shaped region containing DNA. Bacterial DNA is haploid replicates by simple binary fission and maintains bacterial genetic characteristics. Some bacteria may possess extra- nuclear genetic material in the cytoplasm consisting of DNA named as Plasmids or episomes . Capsule and Slime layer Is amorphous viscid bacterial secretion of bacteria surrounds outer layer when diffuses into surrounding medium and remains as a loose under marcated secretion as "Slime layer" when it is organized into a defined structure known as "Capsule" . FUNCTIONS: 1- Antiphagocytic in nature. 2- Antigenic. 3- Virulence. Flagella : Cytoplasmic appendages protruding through cell wall. Composed of a protein (flagellin) (5-20um in length and 0.01- 0.02um in diameter) . Organ of locomotion. All motile bacteria contains either one or more flagella . Part and composition : . Three parts: 1- Flament 2- Hook 3- Basal body Arrangements / types 1 -Monotrichous. 2- Amphitrichous. 3- Lophotrichous. 4- Peritrichous. Fimbriae Hair like appendage projecting from cell surface -Also called as "Pili" . - Composed of protein called pilin. -Unrelated to motility. - Functions: 1-Adhesion .2- Transfer of genetic material. Endospores Are highly resistant resting stage formed in unfavorate environmental conditions . - Depletion of nutrients. - .Sporulation is not a method of reproduction as bacteria is not divide during sporulation . - .each vegetative cells one spore one vegetative bacterium. Morphology of Spore 1- Core 2- Forespore 3- Spore membrane 4- Spore cortex 5- Spore coat 6- Exosporium