

Microbiology: it is the science that deals with study of microorganisms.

Branches of microbiology :

- | | |
|---------------------------|-----------------------------|
| 1- medical microbiology . | 2- Industrial microbiology. |
| 3- food microbiology . | 4- soil microbiology. |

Medical microbiology it is the science that deals with study of pathogenic microorganisms including (pathogenesis , Laboratory diagnosis ,treatment , epidemiology ,control of infection ..etc) .

Branches of medical microbiology includes:

- 1- Bacteriology : deals with study of bacteria .
- 2- Virology : deals with study of viruses causing infectious diseases .
- 3- Mycology : deals with the study of pathogenic fungi of human.
- 4- parasitology : deals with the study of parasites.
- 5- Immunology .
- 6- Genetics

Historical events for discovery of microorganisms :

- 1- Haeckel : 1866 –classified microorganisms into (Protista , Eukaryotes , Prokaryotes , Virusis .
- 2- Antony Van 1693 – could give a description of various types of bacteria , and also invented microscope.
- 3- pasteur : 1857 - He introduced techniques of sterilization and he developed steam sterilization , hot air oven and autoclave .
- 4- Robert cookh (called father of bacteriology) He studies on the culture media and staining techniques.In 1882 he discovered the T.B , and in 1883 he discovered vibrio.
- 5- Neisser 1879 - Gonococcus
- 6- Hansen 1874 - Leprosy
- 7- Gram 1884 - Gram stain
- 8- Frankel 1886 - Pneumococcus
- 9- Klebs - Diphtheria
- 10- Loeffler 1834 - isolated Corynebacterium
- 11- Escherich 1886 - E. coli
- 12- Bruce - Brucella

Bacteria : are unicellular free living organisms without chlorophyl having both DNA and RNA . They are capable of performing all essential process of life such as growth, metabolism and reproduction.

“ Nomenclature of bacteria”

Bacteria have binomenclature system which consist of two words:

The first word is the name of Genus (start with capital letter) ,

The second word is the name of species (start with small letter)

Genus : is a group of similar species strain .

species : is a group in which all individuals are essentially alike .

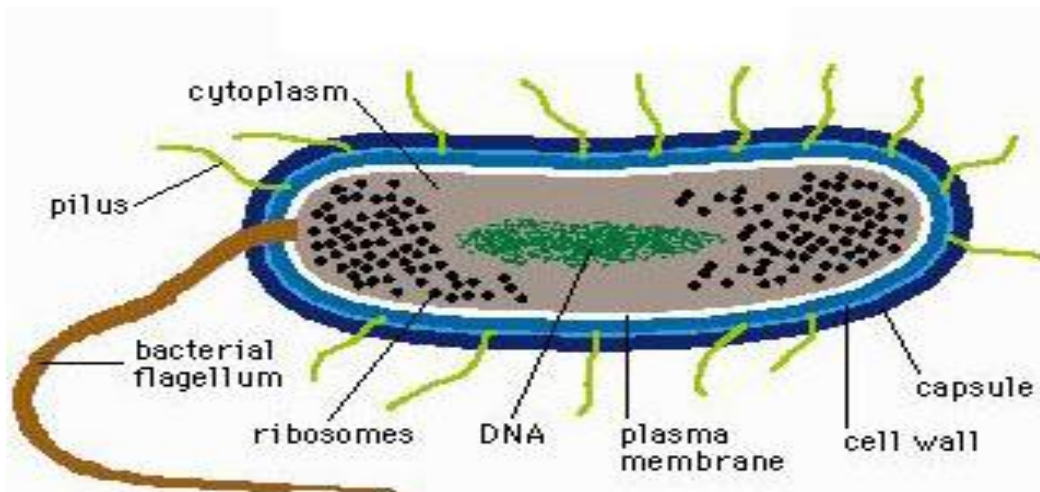
e.g. *Staphylococcus aureus*, *Staph. citreus* , *Staph. albus*.
Samonella typhi
Mycobacterium tuberculosis

“ Shapes of Bacteria”

According to the shape bacteria are classified into :

- 1- Cocci :are spherical shape.On basis of arrangement cocci devided into :
 - a- cocci in Cluster e.g Staphyococci
 - b- cocci in chain e.g Streptococci
 - c- cocci in pairs e.g Diplococci, Neisseria
 - d- cocci in groups of four e.g Gaffkyae
 - e- cocci in groups of eight e.g Sarcinae
- 2- Bacilli : they are rods cylendrical shape.
- 3- Chinese letter e.g Corynebacteria
- 4- Vibrio : they are comma shape (curved rods)
- 5- Spirilla : are spiralled non flexous rods (spirillum)
- 6- Spirochates: are very spirally twisted flexous filament .
- 7- Actinomycets : network shape .

“Structure of bacterial cell”



- 1- Capsule : to protect the cell wall, some spp. of bacteria can form capsule, It is composed of polysaccharide and some of them made of polypeptide .
- 2- cell wall: it is the outer layer covering the bacterial cell. It is strong and rigidly which give the shape of bacteria, it is composed mucopeptide it is play a role in divission of bacteria, and it offers resistance to environmental harmful effects .
- 3- Cytoplasmic membrane: it is covering the cytoplasm,it is composed of lipid.

4 - Cytoplasm: it is a viscous liquid solution containing organic and inorganic solutes .

5 - Nucleus : it is a long filament of DNA which is not surrounded by a nuclear membrane & contains nucleoids.

6 - Ribosomes : these are ribonucleoprotein granules, they are the sites of protein synthesis.

7 - Mesosomes : Are the sites of respiratory enzymes in bacteria .

8 - Flagella: all the motile species of bacteria contain flagella which are long, very fine filaments present on the outer surface of bacteria. According to the arrangement of flagella bacteria are divided into four groups:

a - Monotrichous



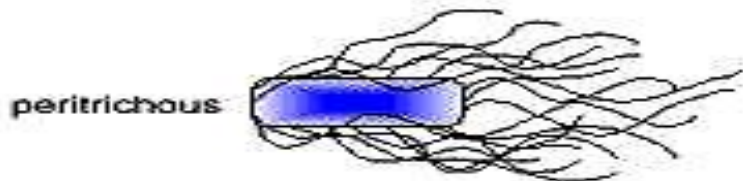
b - Lophotrichous



c - Amphitrichous



d - Peritrichous



9-Fimbriae (pilli) : they are filamentous short thin straight hair like . it helps in attachment to the host cell.

10- Spore : some of bacteria can form spore when the condition is unfavourable like drying, freezing, heat . When the condition becomes favourable the spore germinates and comes out of the bacteria.

Spores are classified into four groups due to their location in the cell :



a - Central spores



b - Terminal spores



c - Sub-terminal spores



d - Free spores

“ Temperature of growth”

For bacteria there is a range of temp at which growth can occur so there is .

- a- Optimum temp
- b- Minimum temp
- c- Maximum temp

There are three groups of bacteria as regards to the temp of growth :

- 1- Psychrophilic: the organisms that growing between (0 – 25 c), these are mostly soil and water bacteria.
- 2- Mesophilic : they grow between (20- 45 c),this group including pathogenic bacteria.
- 3- Thermophilic : some organisms grow between (50 - 60 c) e.g Bacillus

Classification of bacteria according to O₂

- 1- Obligatory erobic : require atmospheric O₂ and can not grow without it e.g Bacillus subtilus .
- 2- Obligatory anerobic : can not grow in the presence of O₂ e.g Clostridium welchii
- 3-Facultative anerobic : can live with or with out O₂ . e.g Salmonella typhi
- 4-micro-aerophilic bacteria : require a small quantities of O₂ e.g Haemophilus influenzae

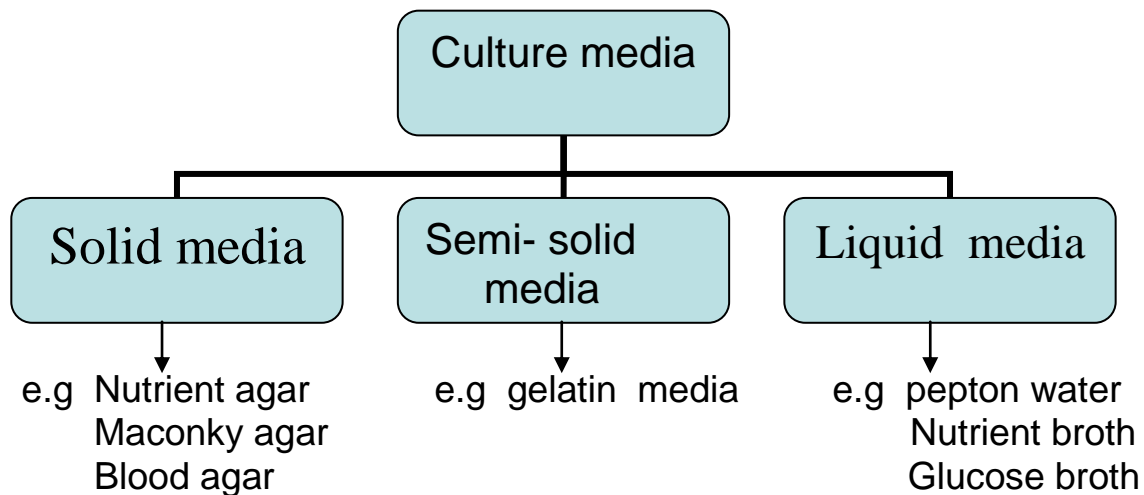
“ Culture media”

Media : is the substances that used to support the growth of microorganism or other cell.On culture media we can study:

- a- the characters of colony .
- b- the biochemical reactions of bacteria.

Agar : it is a substance obtained from some sea plants(Algi),and it contains along chains of polysaccharides ,small amount of protein and inorganic salt.It is used only to solidifying the media.

Agar is Melting at 95 – 98 c and solidifying at 35 – 40 c.



Classification of media according to the state (solidity) :

- 1- Solid media : the concentration of agar 1.5 - 2 % .The advantages:
 - a- characters of colony can be studied
 - b- mixture of bacteria can be isolated
- 2- Semi-solid media : it is between solid media and liquid media ,the concentration of agar 0.2 - 0.5 % it is used for motility of bacteria .
- 3- Liquid media :no agar.the advantage is :the bacteria grow faster due to the free medium.

Types of media according to the function:

- 1- Basal (simple)media : it is the media which contain most of the nutrient that required for growth of bacteria . e.g Nutrient agar e.g Nutrient broth
- 2-Enriched media : many substances such as (blood ,serum) is added to the basal media for fulfillment the growth of some microorganisms, this is known as enrich media. e.g blood agar.
- 3- Selective media :it is contain some chemical substances which inhibits the growth of most microorganisms other than the selective one. e.g Lowenstein Jensens media (malachitgreen inhibits the growth of bacteria other than the Mycobacterium).
- 4- Differential media : the media which containing substance or indicator which will differentiate some spp. of microorganisms from an other spp. e.g maccokey agar in which the lactose fermenter spp. show as red colonies while non lactose fermenter spp. as pale colonies .

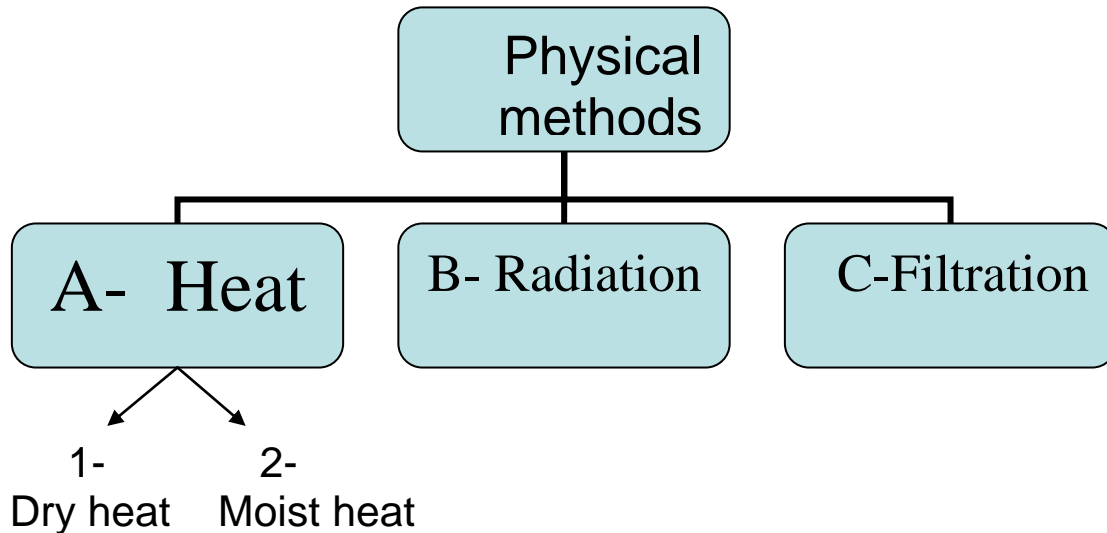
“ Sterilization”

Sterilization: Is the term that means killing of all forms of life of environment.

There are two methods of Sterilization :

i- Physical methods

ii - Chemical methods



1- Dry heat : This includes:

- a- Red heating : it is mostly used for sterilization of inoculation wires loop , forceps, by holding them into the flame bunsen burner till it becomes red .
- b- Flaming: mostly used to sterilization the mouth of culture tube and slide.
- c- Hot air oven: it is mostly requires temp of 160 c for 1 hour or 180 c for 1/2 hour. this is the best method to sterilizing the dry glass ware like petridish , test tube, pipettes.

2- Moist heat : This includes:

- a- Tem below 100 c: pasturisation of milk either at temp 63 c for 30 min (Holder method) or at 72 c for 15- 20 c min(flahs method).

b- Tem at 100 c: Boiling water is killed all vegetative bacteria within 10 min . Tyndalization of culture media which containing sugar and gelatin media .the material is exposed to steam of boiling water at atmospheric pressure(Arnold sterilizer) for 30 min on 3 successive days:

at the first day → steam is killing all vegetative form bacteria .

at the second day → steam is killing all the germinated spores .

the third day → is for a precaution to make sure that all bacteria are killed .

c-Temp above 100 c (by autoclave) :This method is the most widely used for sterilization of culture media, in this apparatus the material for sterilization are exposed to steam under pressure (120 c under pressure 15 pound per inch square) for 15-20 min.

B - Radiation :

1- Non ionizing radiation :this includes:

a - Ultra violet radiation :

sterilizing bacteria in water ,and on contaminated surfaces.

b- Infra red radiation :

sterilizing a large number of disposable syringes in a short time .

2- Ionizing Radiation : e.g. x-rays

C - **Filteration methods**: used for sterilizing liquids that will be damaged by heat such as serum and antibiotic solutions. e.g Asbestos disc.

ii - **Chemical methods** : by using some chemical agents.

Antiseptic agent : is a chemical substance that prevents growth either by inhibiting or destorying microorganism and is used for topical application of living tissue. e.g 70 % alcohol ,stavelone , Halogens(Iodine) , used for skin.

- Bacteriostatic material : act by inhibiting growth of bacteria.

- Bacteriocidal material : act by killing bacteria.

Disiafectant agent: is achemical agents that used for sterilisation of

nonliving or inanimate objects. e.g phenols , formaldehyde.

- phenol : used in 30% solution for sterilizing surgical instruments.

- formaldehyde : used in sterilizing bacteria vaccine.

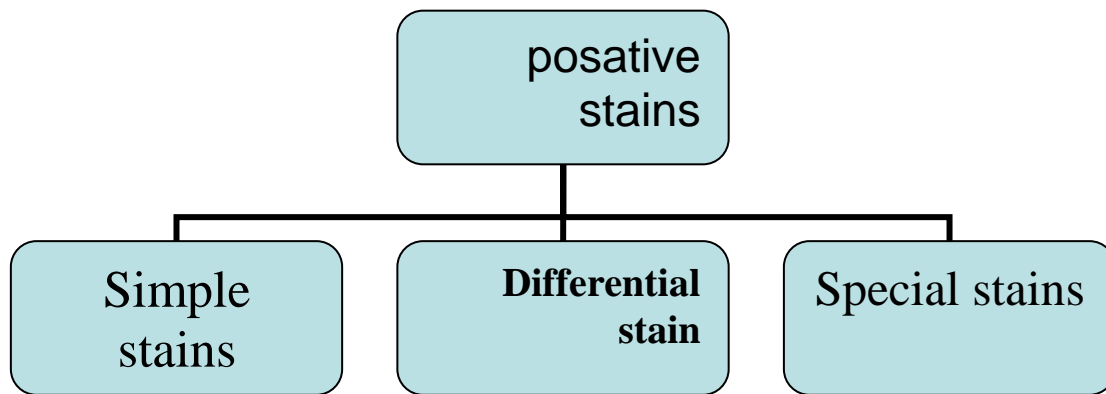
" stains and staining methods "

Bacteria are so transparent when they are examined in the living condition, therefor it is necessary to stain them with dyes to make it visible in order to identify and classify them.

staining methods of bacteria are divided into two groups :

A- Posative stains .

B- Negative stains .



1- Simple stain methods: are the techniques in which we used only one Stain or (dye), the resulting smear will be stained uniform for all spp. with the same color. e.g. methylene blue, safranin, crystal violet.

2- Differential stain methods: are the techniques in which more than one stain are used, then we can differentiate the groups of bacteria. e.g.: Grams stain method, and Ziehl-Neelsen stain method (acid fast stain).

Grams stain technique: is used to differentiate bacteria into two groups:

(Gr +ve) Gram positive bacterial → appear violet color.

(Gr -ve) Gram negative bacteria → appear red or pink color.

Stains and chemical solutions which are used in Gram stain technique:

a - Basic stain → Crystal violet → 1 min

b - Iodine solution → 1 min

c - Decolorizer solution → 95 % Ethanol

d - Counter stain → Safranin → 1/2 min

Ziehl-Neelsen stain (Acid fast stain) technique:

It is used to differentiate bacteria into two groups:

Acid fast bacteria (Mycobacterium) → appear red or pink color.

Non acid fast bacteria → appear blue color.

Acid fast bacteria e.g. (Mycobacterium tuberculosis) are very difficult to be stained by ordinary stains because of their waxy cell wall, therefore they require a strong basic stain (Carbol fuchsin) which resists the decolorization by strong acid solution, so they are called Acid fast bacilli.

Stains and chemical solutions which are used in Ziehl-Neelsen stain technique:

a - Basic stain → strong carbol fuchsin.

b - Decolorizer solution → Acid alcohol.

c - Counter stain → Methylene blue.

3- Special stain methods: These techniques are used for staining one of the structures of bacteria e.g.

b - Spores stain

a - Capsule stain

c - Flagella stain

B - Negative stain: which stains the background, while leaving the bacteria unstained e.g. Negrosin.

“ Infection ”

Infection :Is the lodgement and multiplication of the pathogenic organisms in the tissues of the host. Infection is classified into four types :

“ Types of infection ”

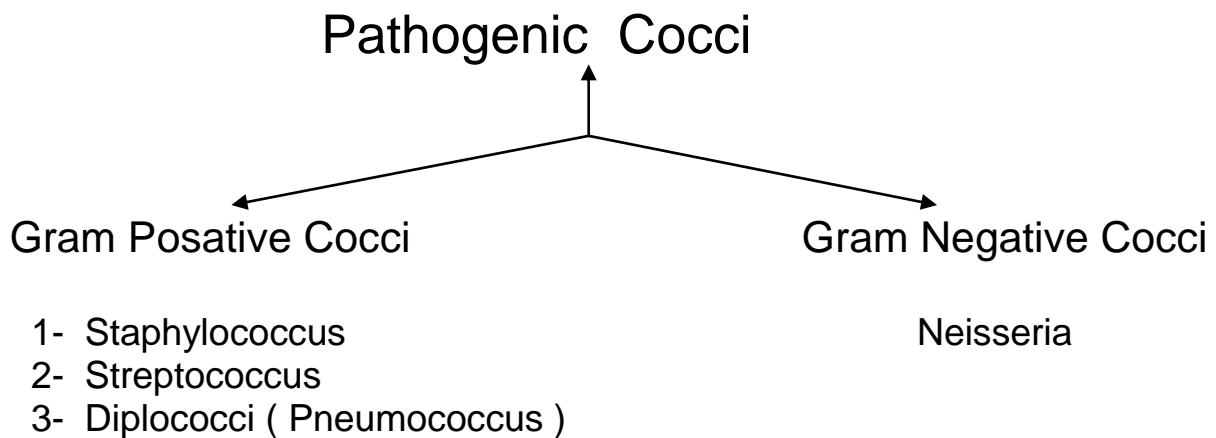
- 1- primary infection: Is the initial infection of the host with the organism .
- 2- Reinfection :Is the subsequent infection of host by the same organism.
- 3- Secondary infection : when the resistance (immunity) of the host become lowered by a pre-existing disease ,then other organisms may set up and caused secondary infection .
- 4- cross infection : This occur when the patient suffering from a disease and a new infection is set up from another host or external source.

" Sources of human infection "

- 1- Human : a patient or carrier person is himself a common source of infection to the others .
- 2- Animals : many infectious diseases are transmitted from animals to human, such diseases are called zoonosis . e.g plague → from rats.
- 3- Insects :Some insects are vectors for transmission of many diseases to human . e.g (Anopheles) → malaria.
- 4- Soil : e.g spores of tetanus bacilli remains in soil for along time.
- 5- Water : : e.g cholera → vibrio , hepatitis → virus.
- 6- Food : contaminated food may be as a source of infection e.g food poisoning by (Staphyococcus).

" methods of transmission of infection"

- 1- Contact : (sexully) e.g syphilis , gonorrhoea.
- 2- Inhalation : e.g Influenza , Tuberculosis.
- 3- Ingestion : e.g colera → (water), Food poisoning → food.
- 4- Inoculation : tetanus,(infection) rabies (dog).
- 5- Insects : malaria ,(dysentery and typhoid)house fly.
- 6- Injection : laboratory infection .



" Staphylococcus spp "

Morphology : spherical cell , arranged in cluster , Gram positive (Gr+ve) ,non motile ,non sporing , aerobic , grow at 37 c on most media.

Classification : Staph are classified into three species according to pigment production of their colonies on nutrient agar :

- 1- **Staph aureus** :produce golden colonies and pathogenic.
- 2- **Staph albus** : produce white colonies non pathoenic (skin normal).
- 3- **Staph citrus** : produce lemon yellow colonies and non pathoogenic.

Pathogenecity : Staphylococcal infections (diseases) may be:

- 1- Cutaneous infection : e.g. boils , abscess, eye infection.
- 2- Deep infection : e.g. tonsilitis , pharyngitis , abscess of breast,and staphyococcal septicemia
- 3- Staphylococcal food poisoning: when some one had taken foods (e.g meat , fish ,milk products) which are contaminated with enterotoxin produced by staphylococci,this will cause food poisoning (diarrhoea and vomitting) within(6 h) after taking contaminated food.

" Streptococcus spp"

Morphology : spherical or oval cells, arranged in chains ,Gram positive, non motile ,non sporing , aerobic , and some time capsulated . they require media enriched with blood . grow at 37 c . they are widely distributed in nature .they may be found in water , dust .

Classification : streptococci divided into three groups according to their haemolytic activities on blood agar :

Alpha haemolytic streptococci (α) : produce a partial haemolysis of the red blood cells on blood agar , which resulting in a greenish brown discoloration surrounding the colony.

e.g Streptococcus viridance , Streptococcus pneumonia

2- Beta haemolytic streptococci : produce a complete hemolysis of red blood cell on blood agar, which resulting in a completely clear zone surrounding the colony.

e.g Streptococcus pyogene

3- Gamma haemolytic (Non haemolytic) streptococci :they have no effect on red blood cells and produce no haemolysis.

e.g Streptococcus faecalis

Pathogenicity of Streptococcus spp:

Streptococcus pyogenes

1- Respiratory infection → sore throat (tonsilitis)

2- Scarlet feve → Erythrogenic rash.

3- Skin infection → wounds ,burns.

4- Rheumatic fever

5- Genital tract → puerperal sepsis

6- other infection e.g abscess of organs such as lungs,liver,kidney,brain

Strep viridance → subacute bacteria (endocarditis)

Strep faecalis → urinary tract infection

“ Diplococcus (Strept. pneumoniae) “

Morphology : they are gram postive, lanceolate diplococci occur in pairs. capuslated , non motile ,non sporing , they require enrichment of media with blood or serum , they grow best at 37 c and at PH 7.6 ,and they are aerobic and facultative anaerobic.

Pathogenicity : cause many diseases such as :

1- lobar pneumonia

2- branchio pneumonia

3- pneumococcal meningitis.

4- otitis media.

5- sinusitis.

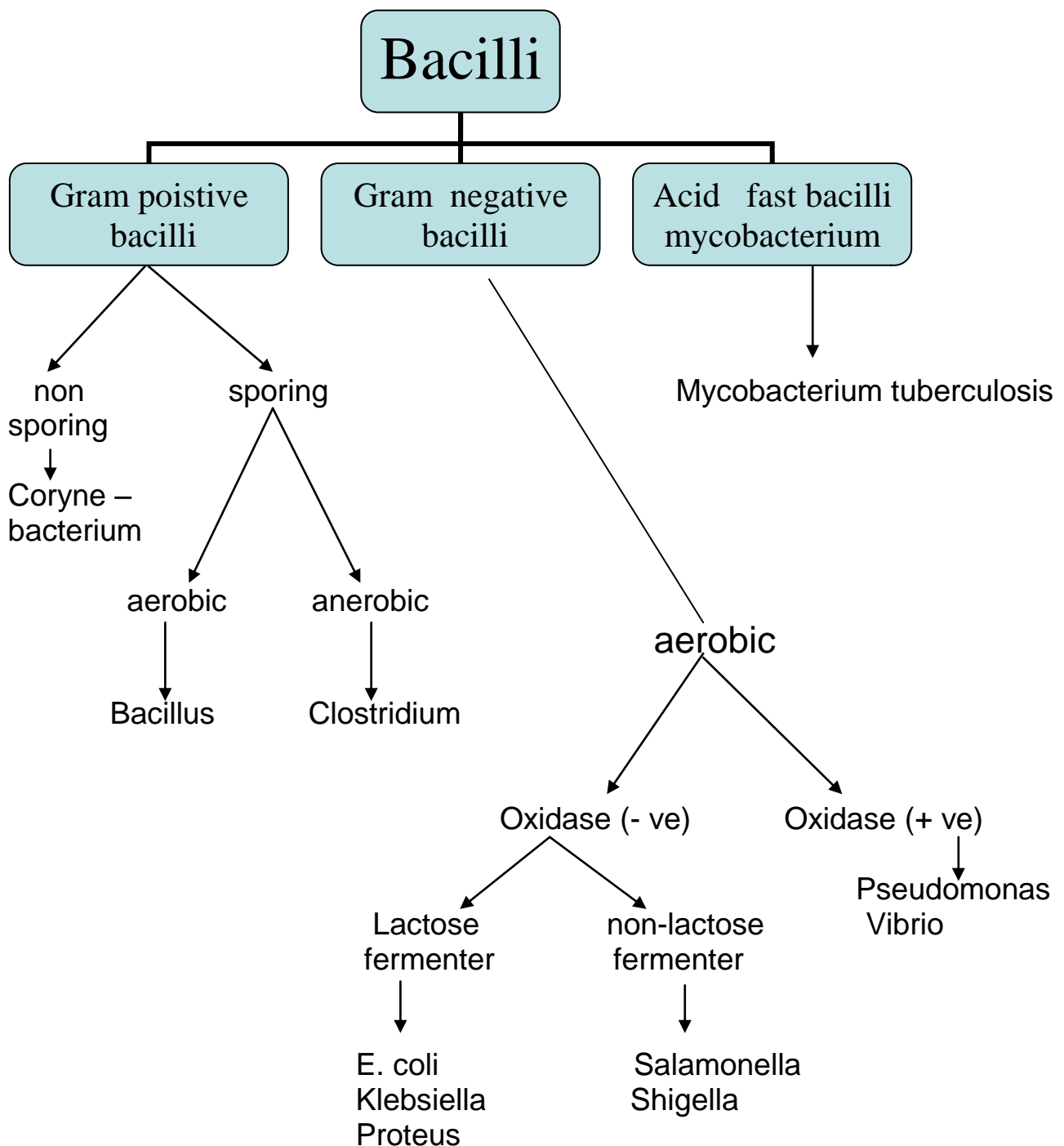
" Neisseria "

Morphology : they are gram negative cocci arranged in pairs , oval or spherical , non motile , non capsulated , aerobic . grow best in atmosphere containing (5-10%) of CO₂ on heated blood agar (chocalat agar) . the colonies after 48 hr incubation are creamy and transperant , non pigmented , non haemolytic.

Pathogenicity :there are 2 pathogenic spp:

1- **Neisseria gonorrhoea** → cause gonorrhoea urithritis.

2- **Neisseria meningitidis** → cause meningitis.



" Mycobacterium "

General characters : they are acid fast bacilli, slender rod , aerobic , non motile , non capsulated ,non spring . can not grow on ordinary media ,then they requie enrichment media e.g. Lowenstine Jensen's medium ,and they incubation for 4-8 week at 37 c ,colony looks is rough and creamy color.

Pathogenic species are:

- 1- Mycobacterium tuberculosis → causes tuberculosis in human.
- 2- Mycobacterium leporea → causes leprosy in human.

"Corynebacterium "

Morphology : Gr +ve bacilli, appear as chinese letters,metachromatic granules are present seen by Albert or Neisser's stain .they require enrichment mediasuch as Loefflers- serum agar and Blood Tellurite agar.

Pathogenecity :

- 1- Corynebacterium diphtheriae pathogenic ,caused diphtheria in children .
- 2- Corynebacterium diphtheroid non pathogenic, present as commensal organisms in mouth and throad.

" Bacillus"

Morphology : they are gram positive bacilli , occuring in chains ,thick ,with convex end ,aerobic , motile , central spore ,present in air, water.the colonies on nutrient agar are dry , irregular, opaque, grayish white.
On blood agar————→ No heamolysis

Pathogenecity :

- 1- Bacillus subtilis —→ non pathogenic
- 2- Bacillus cereus —→ caused food poisonin
- 3- Bacillus anthracis —→ pathogenic, caused anthrax disease in human and animals.

"Clostridium"

General characters : are gram positive bacilli ,anaerobic, forming spores.

Pathogenic species:

- 1- Clostridium tetani: caused tenanus disease ,making alpha-haemolysis on blood agar medium ,forming spore which is terminal and projecting out side the bacilli (dram stick appearance).
- 2- Clostridium perfringens and Clostridium welchii
These are caused gas gangrene disease, beta-haemolysis on blood agar, growing on cooked meat medium at 37 c ,forming oval subterminal non projecting spore.
- 3- Clostridium botulinum : caused botulism disease (food poisoning). forming oval, central and projected spore. Incubation period 12-36 hour.

“ Enterobacteriaceae ”

general characters :Is the family of bacteria (several genus)which present in the intestine of human. All of them are gram (-ve) bacilli , motile with peritrichate flagella or non motile, non sporing ,they are grow on simple medium like N. Agar and macconkey agar and ferment carbohydrates like lactose ,glucose , sucrose , mannitol . Enterobacteriaceae include :

1- “ Escherichia coli ”

Morphology : G-ve Bacilli ,non capsulated ,non sporing.Lactose fermenter → pink colonies on macconkey agar.The presance of E. coli in water is an indicator of water pollution by human faecal materials .

Pathogenicity :

- 1- urinary tract infection → cystitis pyelonephritis.
- 2- Gastroenteritis → summer diarrhoea in children.
- 3- pyogenic infection → wounds infection and abscess.

2- “ Klebsiella ”

Morphology : G-ve bacilli , non motile , capsulated , lactose fementer on macconkey agar. They produce mucoid colonies on N.agar.

Pathogenicity :

- 1- **Klebsiella pneumoniae** → cause pneumoniae.
- 2- **Klebsiella aerogenes** → cause urinary tract infection.

3- “Salmonella ”

Morphology : G-ve bacilli, motile with peritrichous flagella , non lactose fermander on macconkey agar.

Enrichment media → selenite broth and tetrathinate broth.

Pathogenic species : Salmonella spp. which can infect human are caused typhoid fever (entric fever): e.g :

- 1 - **S. typhi**
- 2 - **S. paratyphi A**
- 3 - **S paratyphi B**
- 4 - **S. Para typhi C**

Salmonella spp. which can infect animals are caused food poisoning , gastor enteritis and septicaemia.e.g 1- **S typhimurium** 2- **S enteritides.**

Serological test (Widal test)

O (somatic antigen) and H (flagella antigen)

4- “ Shigella “

Morphology : G(-ve) bacilli, non motile, non capsulated, non lactose fermenter on macconkey agar (except S. sonnei which can ferment lactose and form pink colonies).

Selective media → Deoxycholate citrate agar (D.C.A)

Serological test : only (O) antigen . and no (H) antigen.

There are 4 species on the basis of (O) antigen:

- 1- Sh. dysenteriae → cause bacillary dysentery.
- 2- Sh. Flexneri
- 3- Sh. boydii
- 4- Sh. sonnei

5- “ Proteus ”

Morphology : G(-ve) bacilli, non motile, non lactose fermenter, grows on simple media like N. agar and macconkey agar . spreading of the colonies called swarming.

P. vulgaris (swarming)

P. morganii non swarming cause urinary tract infection and wounds infection.

6- “ Pseudomonas ”

Morphology : G(-ve) bacilli, non capsulated, motile, non sporing . it gives musty or earthy smell. On N. agar colonies show green colour due to the production of pyocyanin pigment by the bacteria. Oxidase test (+ve) positive. present in soil and water . The only pathogenic spp. is:

Pseudomonas aeruginosa or (P. Pyocyanea) : → wound infection , U. T . I , otitis media

7- “ Vibrio ”

Morphology : G(-ve) , comma shaped , motile by polar flagellum , non lactose fermenter , oxidase test (+ve) , on macconkey agar has colourless colony. Enrichment media → Alkaline peptone water PH 8.6 (T.C.B.S) media → thiosulphate citrate bromothymol blue and sucrose is widely used.

e.g vibrio cholerae → cause cholera

" Coccobacilli "

Are a group (family) of bacteria .**all are Gr (-ve) coccobacilli.** These include :

1- Yersinia:

Bipolar non motile, non sporing ,with rounded end and convex sides..

-on N.agar → transparent colony become opaque on continued incubation.

- on blood agar → dark brown colony due to absorption of haemin pigment.

- on macconkey agar → colourless colony.

e.g Yersinia pestis → cause plague

2- Bordetella :

e.g Bordetella pertussis → cause whooping cough .

Culture → Bordet – gengou – glycerine potato blood agar media.

3- Brucella

They are strict anaerobes ,with addition of 10% CO₂ . temp is 37c. Incubation period is (4-30) days.

e.g Brucella abortus → cause brucellosis (malta fever or indolent fever) which transmitted from animals (cows) to human.

Laboratory diagnosis: 1- Serological test 2- Blood culture

4- Haemophilus :

e.g Haemophilus influenzae

Non motile ,Gr(-ve) coccobacilli, infected human and animals.They are characterized by their requirement for one or both of two accessory factors called (X-factor and V-factor) present in Haemophilus species.

X-factor : present in blood, it is necessary for the synthesis of catalase and other enzymes necessary for aerobic respiration.

V-factor: present in red blood cells,it is synthesized by some fungi and bacteria (staph aureus) .It is apparent to act as hydrogen acceptor in the metabolism of cell ,this is called (satellism phenomena).

Satellism : Staphylococcus is streaked across blood agar plate on which Haemophilus influenzae has been inoculated . at 37 c over night incubation we will find large, and well developed colonies of Haemophilus influenzae along side the streaked of Staph aureus, and smaller colonies further a way. This is called satellism.

Pathogenicity:it is present normally in nasopharynx and tonsillar region,and may be caused → meningitis, otitis media , pneumonia, endocarditis.

“ Viruses ”

Virus: Is unicellular, ultramicroscopic microorganism (particle). Contains either RNA or DNA. Reproducing only inside the living cells.

General characters :

- 1- Do not possess cellular organization.
- 2- Contain only one type of nucleic Acid either RNA or DNA (never both).
- 3- Lack necessary enzymes for protein and nucleic acid synthesis.
- 4- Can multiply only inside the living cells by complex process called replication (not by binary fission).
- 5- Unaffected by antimicrobial or antibiotics.
- 6- Sensitive to the interferons which is a chemical substances that give resistance to the immunity system.

Morphology

Size of Viruses :

Viruses are varied in their size, The largest virus is the (Pox Virus) which measuring about 300 nm. The smallest virus is the (Foot And Mouth) Virus measuring about 20 nm.

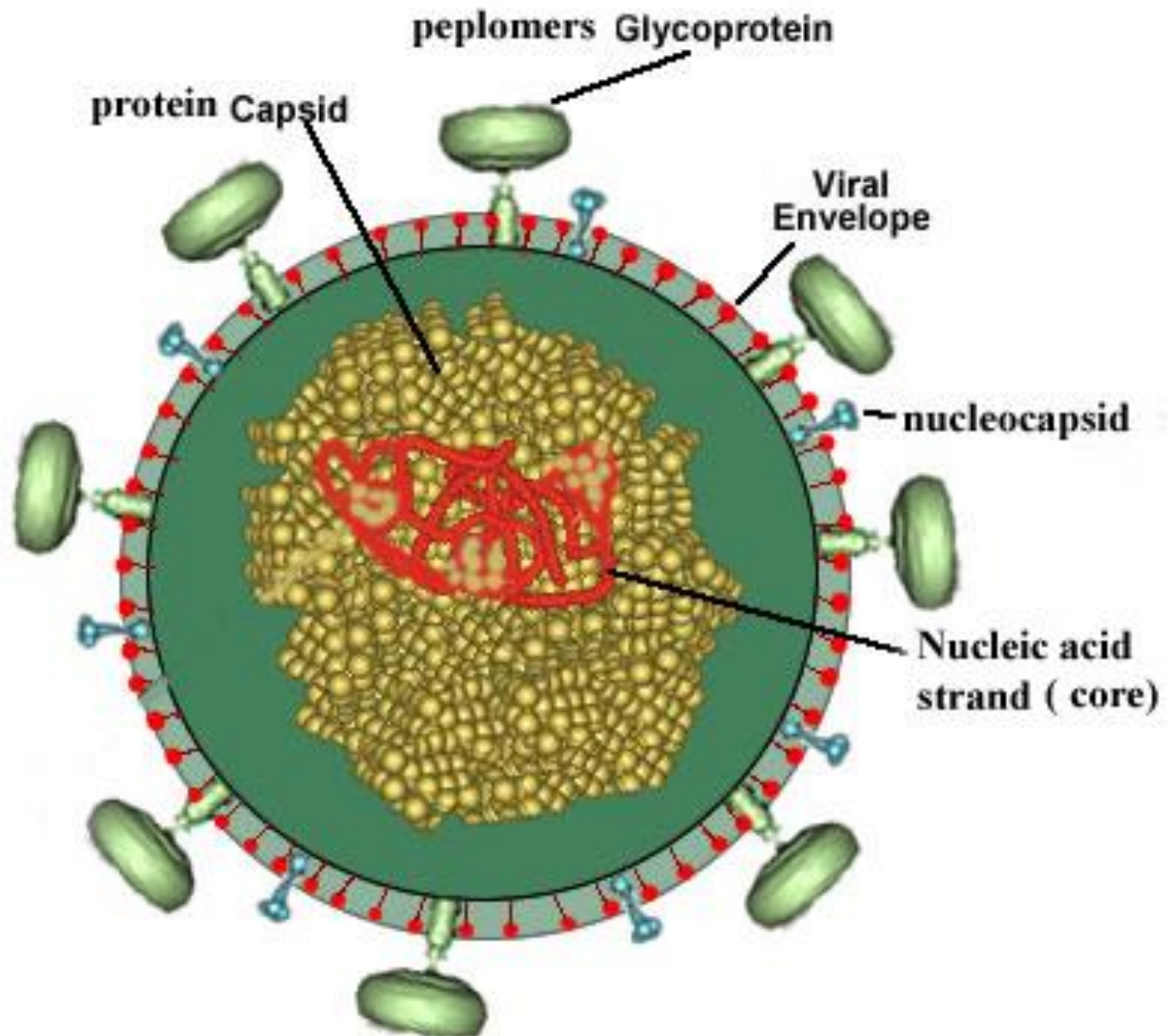
Shape of Viruses :

Viruses are also varied in their shape e.g. Rabies Virus has bullet shape, Pox Virus has brick shape, Influenza Virus Has spherical shape, and the Bacteriophage virus has a head, neck, and tail.

Structure of Virus :

- 1- The virus has a central core of nucleic acid which is either RNA or DNA.
- 2- The nucleic acid is covered with protein coat called capsid.
- 3- The capsid is composed of number of Sub-units called nucleocapsid.

- 4- The virion may be inclosed by envelope.(sometimes non-enveloped).
- 5- Protein sub-units may seen as a projecting on the surface of the envelop and are called peplomers.



Some Viral Diseases :

1. Influenza Virus. 2. Measle Virus. 3. AIDS Virus. 4. Mumps Virus.
5. Hepitites Virus. 6. Small Pox Virus. 7. Poliomyelitis Virus.

“ Mycology ”

Mycology: Is the science which deals with the study of fungi. The diseases by fungi called mycosis.

Fungi : Are plants that has lack chlorophyll and reproduced by spores.

General characters of fungi

1. All species of fungi are aerobes need O₂ for growth.
2. Nutritional requirement to growth of fungi is simple e.g : saburate agar.
3. Optimum temperature for growth of fungi is 28°C, for 1 week incubation.
4. Fungi are affected by physical and chemical agents.
5. Resist spores destroyed by sterilization method and chemical antiseptic.
6. Fungi growth in PH(2-9) , and grow best in acidic PH(6).
7. Treatment of fungul diseases by using antifungal material e.g Nystatin.
8. Fungi may reproduced sexually or asexually or by both methods.

Classification of fungi according to morphology:

- 1. Molds** : most are consist of microscopic branching filaments called (hyphae) which are normally divided with septa into cells. Ex:(Rhizopus).
- 2. Yeasts** : when fungi are appear unicellular, spherical or oval shape ,and reproduce by budding, generally called yeast.ex:Cryptococcus neoformans.
- 3. Yeast-like fungi** :when the hyphae represents pseudo hyphae which are elongated budding cells,often linked in branching chains , and which are superficially resemble hyphae. Ex: Candida albicans.
- 4. Dimorphic fungi** : a fungus which occurs in two different forms according to the environmental culture , they are appear as filaments on the culture media at 22°C and appear as yeast at 37°C and in the human body. for example some pathogenic fungi are filaments (mycelia) in culture ,and yeast like in infected tissues. ex: Histoplasma capsulatum.

Reproduction of fungi

1. Sexual reproduction:

The formation of specialized structures that facilitate fertilization.

Nuclear fusion resulting in the production of specialized spores.

These sexual spores are produced by different ways such as:

- a- **Cospores:** formation and combination of spores in a structure like sacs.
- b- **Zygosporangia:** fertilized spore form after combination of the same gametes.
- c- **Oospores:** fertilized spore form after combination of different gametes.
- d- **Basidiospores :** spores form on the tips of fingers-like branches.

2. Asexual Reproduction: this occurs by:

- a. Fragmentation .
- b. Budding .
- c. Fission .
- d. Formation of asexual spores.

Types of asexual spores :

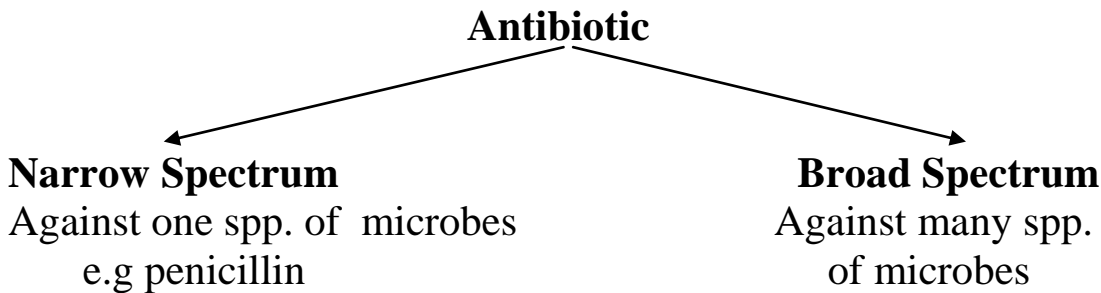
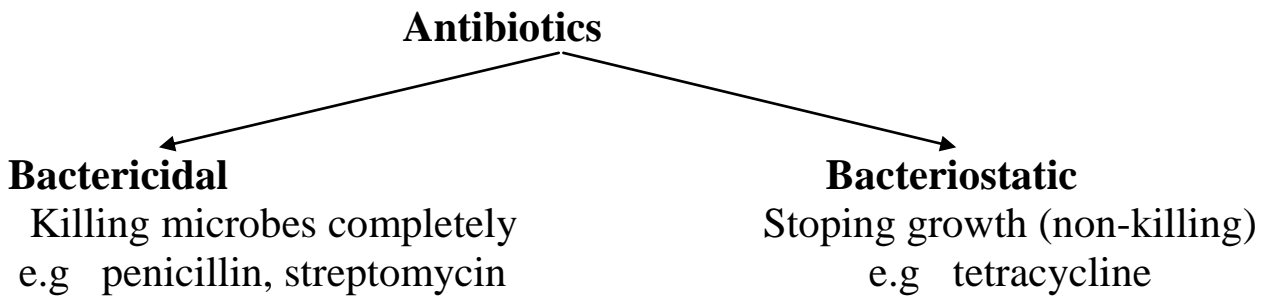
- 1. **Chlamydo spores :** formed when a cell of hyphae become swell up and develops a thick resistant wall.
- 2. **Arthro spores :** formed when septation followed by fragmentation of hyphae.
- 3. **Conidio spores :** spores produced externally on a specialized hyphae
- 4. **Sporangio spores :** spores produced on a spherical cell (sporangium) at the end of specialized hyphae called a sporangiophora.

Classification of fungi according to their sites of infection

- 1. **Superficial Mycosis :** these affect the surfaces like skin, hair.
- 2. **Cutaneous Mycosis :** skin, hair, eye and ear.
- 3. **Subcutaneous Mycosis :** nasal mycosis and smooth skin like bucal Mouth.
- 4. **Systemic Mycosis :** primary infection in lung , bone , and kidney.

“ Antibiotics ”

Antibiotics :are substance which produced by some living microorganisms and can inhibit some other microorganisms. ex: pencillium.



Mode of effect Antibiotic on Microbes:

1. Destruction of cell wall synthesis.
2. Destruction of protein synthesis.

Sensitivity Test (Sensitivity of microbes to Antibiotic discs :

(S) is reffers to Sensitive Antibiotics ,it shows a clear zone of inhibition on the culture medium with a diameter more than 3 mm around the Antibiotic disc.

(MS) is reffer to Intermediate Sensitive Antibiotics, diameter of inhibition is between 2-3 mm.

(R) is reffer to resistant Antibiotics ,with no zone of inhibition or zone less less than 2 mm .

“ Animal Cells ”

General Structure :

1.

Cell Wall : it surrounds the contents of the cell. It consist of two layers of phosphoric lipids, the cell wall used in organization of water transpiration between the inside and outside of the cell.

2. **Cytoplasm:** it is a living partion of the cell ,it lies out of the nucleus and covered with cytoplasmic membrane. It consists of water 80% , Protein 15% , lipid, sugars, and solts 5%.

3. **Nucleus:** it surrounded by the nuclear envelope and contains :

- a. Nucleoplasm.
- b. Chromatin network.
- c. Nucleolus: it consists of Ribo-nucleic acid (RAN) and protein.
- d.Chromosomes: to carry deoxyribonucleic acid (RNA).

4. **Endoplasmic reticulum:** it has two types:

- a. Rough E.R. : contains Ribosomes
- b. Smooth E.R.

5. **Mitochondria:** it is the center of providing the energy to the cell. It stores the energy as adenosine triphosphate (ATP) the main function of mitochondria is cellular respiration.

6. **Golgi apparatus:** it is important for:

- a. Built the complex sugars.
- b. Secretion the protein that will be leave the cell.
- c. Secretion complex sugars, protein, hormones and enzymes.

7. **Lysosomes:** it can digest large particles like proteins and nucleic acid to smaller units.

8.**Cilia and Flagella:** present in some aquatic motile unicelular organisms.

Cell division: 1. Somatic cells. 2. Germ cells or sex cells (Gametes).

Types of division: 1. Amitosis. 2. Somatic mitosis. 3. Meiosis.