



University of Jordan
Faculty of Medicine



Medical Committee
The University of Jordan

Introduction to

Microbiology

Title :

Bacterial growth

.....

Professor:

Dr. Asem A-Shehabi

.....

: 4

:

Slides

Handout

Sheet

Done by: Sura Aldgheim

.....



Price:

Designed by:
Wassem Kamal

M.D. Class of 2018

University of Jordan
f groups/Doctor2012
W http://medstudygroup.weebly.com



-Growth requirements for bacteria:

In relation to this topic we have mentioned before that bacteria, like human cells requires essential nutrition...such as minerals in addition it also requires physical (ex: pH) and physiological conditions and all these requirements should be applied once we want to detect or isolate the causative agent for clinical specimens and this of course could be accomplished in the laboratory by preparing culture media and it should contain all the requirements necessary for propagation (to increase the number of cells in order for it to be suitable for running any identification tests ,whether this causative bacteria is gram + or -)we have to know:

1-their chemical reactions

2-and not always but sometimes genetic conformation tests

According to slide #20:

We can classify bacteria depending on their source of nutrition into:

1-**Heterotrophic** bacteria : this type of bacteria should be supplied for complex organic compounds such as proteins of meat, amino acids, a source of carbon dioxide, minerals, sometimes polysaccharides in addition to water which is required for growth Ex.(all human commensal pathogens)

2-Autotrophic:

Usually utilizes a source of CO₂ or CO or any other type of chemical carbon compounds which can be used by the carbon cycle

*some of them require light in order to absorb energy and have the process of metabolic activity which are called photoautotrophic

*others oxidize nitrogen (found in a percentage of 78% of the atmosphere) or sulfur and are called chemoautotrophic bacteria

3-**saprophytic** bacteria: in relation to the environment some type of bacteria that are found around humans and animals are non-pathogenic which are considered as non important in causing disease

*these type take energy from fermentation/respiration

*are found in nature, decaying materialand are important in circulation of minerals in nature

The doctor said “as we mentioned before the term commensal bacteria in relation to the type of bacteria that adapts in our human body (oral cavity,intestinal cavity,skin) are adapted to live under certain proximal conditions which favor their growth and there is a type of biological equilibrium between these bacteria where one of them can produce an end product that supports the growth of another ..so they are examples of communities and this is actually where the term ‘commensal’ came from referring to communities and how they manage to live together”

-Culture media:

According to slide 21...

We have many types of culture media depending on the type of organism:

-universal culture media:such as blood agar which contains all nutrition (carbohydrates ,proteins ,sugar ,minerals) and 5% of human or animal blood

It should be Neutral (pH 7-7.2)

There are many other types of media that we will mention in each type of organism we take :

1-Neutrophilic bacteria:

*considered the culture media for human pathogens because the majority of them whether opportunistic or true (commensal) manage to grow well at ph=7-7.2

2-Acidophilic:

*ph<5

*few numbers that are considered of importance

*Ex.Lactoacid bacteria which is found in the vagina of young ladies...and in intestines of newborns that last for a few weeks or months and then they will be replaced by other neutrophilic composed of aerobic ,anaerobic and facultative anaerobic bacteriaand of course lactobacillus in yoghurt

3-Alkaline media:

*very few numbers

*found in water mainly

*some might produce infection in our body like the causative agent of cholera .

_In relation to temperature :

1-Mesophilic bacteria:

*20-40C.....most human commensal and pathogens

*to be more specific 35-37C is the optimal temperature of the human body so this bacteria will grow very well at this range of temp. but animals such as birds have a body temp. of about 42C

So bacteria can grow in birds at a temp.>40C

2-Thermophiles:

*temp.> 60C .. 60-80C

*common in hot springs

*is rarely related to disease like saprophytic bacteria so it cant be a direct causative agent of disease

*not important in clinical practice so as doctors we don't normally look for this type of bacteria

3-psychrophilic bacteria:

*survives at temp.<10C

*important because it is found in the environment and might contaminate any type of food ,fruit vegetation etc..

*low temp. are supportive in this kind of bacteria so just putting the food in the fridge doesn't help ...it might allow it to increase in number and might change the flavor of the food and break down proteins and sugarsso it is associated with food spoliation which in some cases can lead to toxicity

*under heat or cooking this bacteria isn't pathogenic anymore

^^Q:If we place bacteria in the fridge temp. (3-4C) what happens?

It depends, it might survive for short or long periods of time because other factors play a role in this condition such as the physiological conditions.. that is if the bacteria is in an isotonic medium or hypertonic (concentration of salts)so it is really related to how we preserve food and prevent bacteria to survive

Note:-we concentrate more on neutrophilic bacteria because human pathogens are associated to human infections whether opportunistic or commensal bacteria which under certain conditions can also cause infection

-Counting of bacteria:

*bacteria counting isn't important for knowing the causative agent of a disease, we aren't concerned if the patient is infected in 100,000 bacterial cells or even 1 single cell but what really concerns us is the clinical features or in other words the symptoms the patient shows and the results of the infection

*but counting of bacteria can be useful for testing the bacteria for end products to study the physiology of the bacteria as well as industry ...maybe the only type of specimen which we should know the number of cells is in urine obtained from the case of the urinary tract infection so we can call it a true infection (which will be mentioned later)

Refer to slide #22:

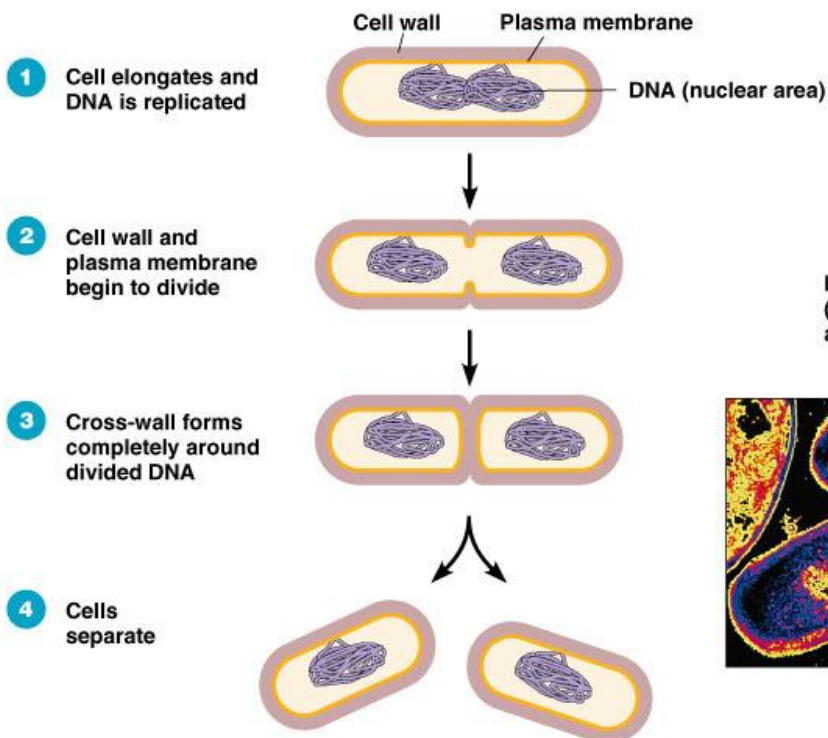
-In this slide , you can observe a solid culture medium.(on the left)a Petri dish which has all type of nutrients in the medium

The dots are bacterial colonies (*a clusture of cells*) , each colony is originated from a single cell and during replication (binary fusion) within the incubation period(between 18-24hours) these colonies grow rapidly into facultative, aerobic and anaerobic bacteria each cell will produce up to at least 10,000 cells within 24 hours sometimes 50,000 or 100,000

The number of colonies is used to measure the growth rate of bacteria (how much they replicate within a period of time).but not all colonies are countable some are confluent growing ...it's hard to count them even with electronic devices ,so scientists resort to “**Dilution**” which is a Liquid culture medium .This liquid culture medium is composed of “Broth medium” which is *a fluid medium composed exactly as the solid medium except that it doesn't contain “Agar”* .

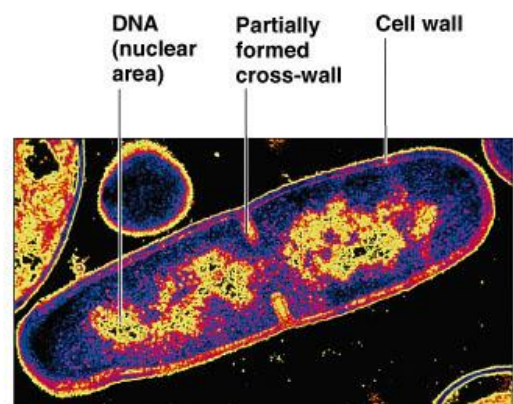
* The **turbidity** (العكورة) of broth medium is an indication of bacterial growth

*Bacterial growth: Binary division



(a) A diagram of the sequence of cell division.

Copyright © 2004 Pearson Education, Inc., publishing as Benjamin Cummings.



(b) A thin section of a cell of *Bacillus licheniformis* starting to divide.

This type of growth can be summarized:

1-within the cell we have a single chromosome in the cytoplasm which is highly concentrated.

The bacterial cells acquire increase in energy during the active process it activates its metabolism this means that the bacteria is getting ready for reproduction so it might absorb more nutrients especially water ,the bacteria also becomes elongated

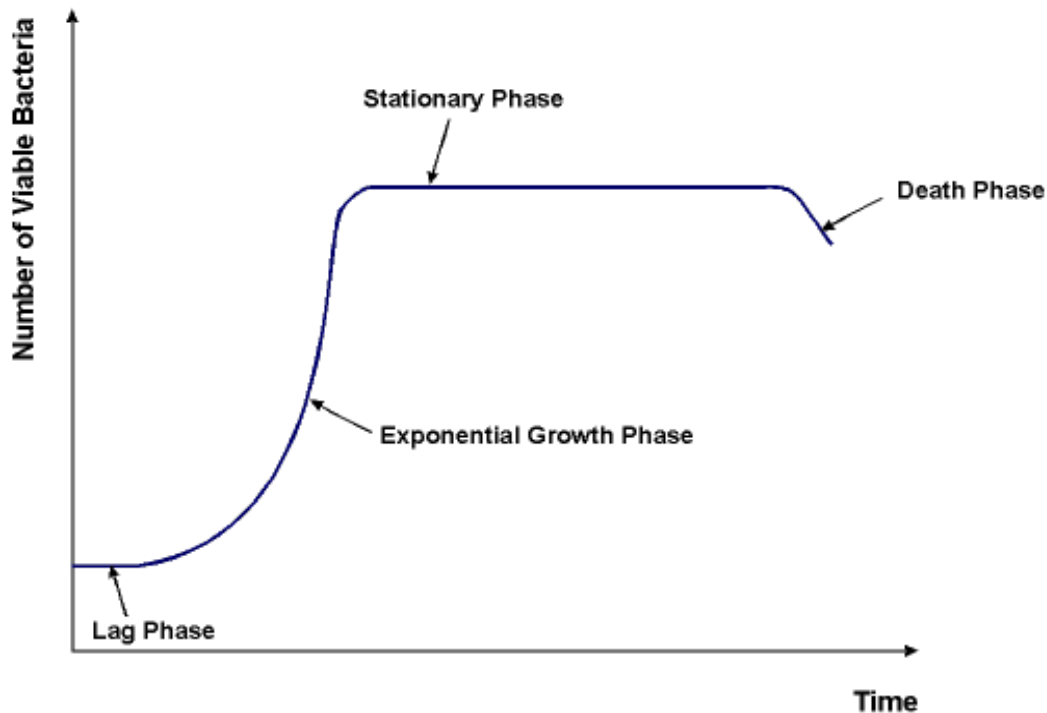
2-the beginning of the separation of each double helix copy of DNA (chromosome)at the same time the middle of the bacteria starts to produce a separation of cytoplasmic membrane and cell wall the separation starts from the outside to the inside (an invagination)

3-the slow separation of the 2 identical cells occurs which contains all of the genetic information by the presence of 1 copy of the bacterial chromosome (double helix)

*Note:1-the complimentary sequence of the DNA is built with the help of polymerase in order to produce the double DNA helix or else the linear DNA cant survive because of the presence of an enzyme called restriction endonuclease which breaks the DNA down

2-this type of growth has a certain pattern ---→the single cell becomes doubled and these cells are also doubled (4,8,16....cells and so forth)

3-this process takes about 20-25 minutes which is a short time.....this time is known as the generation time(the time needed for 1 single cell to turn into 2 cells) but it also varies, some bacteria need have an incubation period of 15 or even 24 hours.(such as growth in the causative agent of tuberculosis which is very slow ..to recognize it it might require 1-6 months)



This is what is so called the bacterial growth curve: it has 4 phases of growth that depend on the amount of nutrition all kind of bacteria go through this

1. Lag phase : adaptation phase During lag phase, bacteria adapt

themselves to growth conditions. It is the period where the individual bacteria are maturing and not yet able to divide. Number of cells is limited in this phase .

2. Exponential growth phase : is a period characterized by cell doubling

3. Stationary phase : is due to a growth-limiting factor(end products) this is
Mostly because of the decrease of a nutrients in this phase.

4. Death phase:at this phase bacteria run out of nutrients and die.

Plus, certain lysing (autolysing) enzymes in cell walls become activated and cause cell death.

*This sheet might not be enough please refer to slides