Lab 5

<mark>Factor effecting microbial growth</mark>

Microbial growth is effected by many factors: some of them are auto factors refer to genetic material and structure of the cell that determine microbial behavior towards the environment and responsible of microbial variation in nature.

Some of environment factors directly influence the growth, so they assist in studying M.O. and used efficiently in controlling line particulary in discarding of harmful M.O. especially pathogens species because microbial response differ towards environment factors e.g: one factor could be lethal and limiting for one species but enhancing the growth of another factors affecting M.O. growth divided into two categories:

<mark>1- Physical factors</mark>

<mark>2- Chemical factors</mark>

Sometimes there was interference between Physical and Chemical factors that can not be separated strictly in so termed physiochemical factors.

Physical factors include:

1-Temperature

2- Hydrogen ion concentration(pH)

3- Osmotic pressure

Each microbial has its own cardinal temperature that facilitate growth which are:
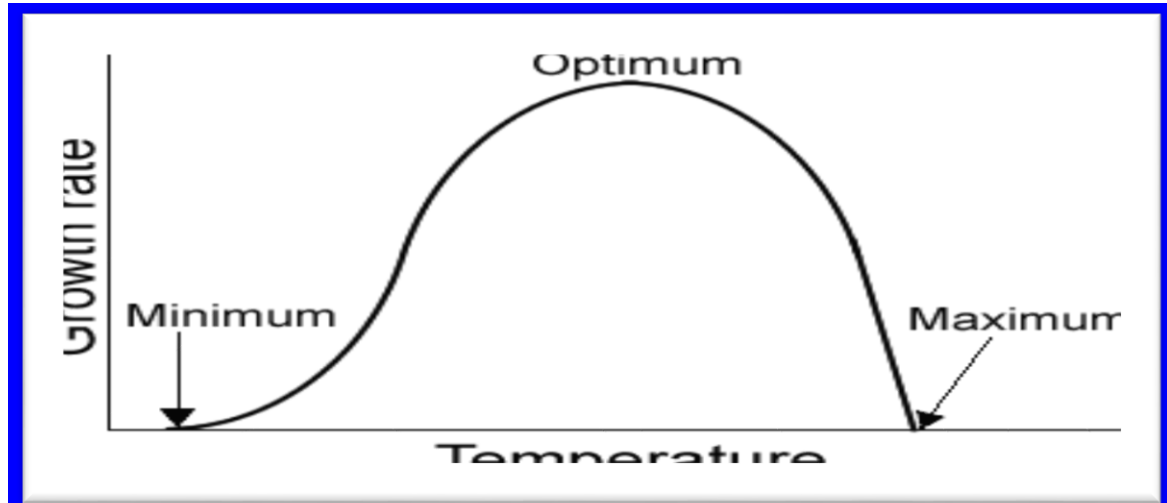
<mark>1- Optimum temperature</mark>

The temperature at which the most rapid rate of multiplication occurs, the microbe shows shortest g.t.

<mark>2- Minimum temperature</mark>

The lowest temperature at which microbe grows, all microbe will survive but show negligible growth.

3- Maximum temperature

The highest temperature at which growth occurs, temperature only slightly above this point frequently kill microbes by inactivating critical enzymes.

Bacteria could be divided in to 3 major groups according to its optimum growth temperature.

1-Psychrophiles: That microbes capable of growth at (-5 - 20)c°

Ex: Sea bacteria, *Flavobacterium* , *Pseudomonas fragi*.

2-Mesophiles: That microbes grow in temperature from (20-50)c° , most known m.o. occur in this group.

Ex: *Clostridium sp* , *Escherichia coli.*

3-Thermophiles: That m.o. grow best above 50 c°.

Ex: *Bacillus stearothermophilus*.

Temperature

Temperature is one of the most important factors that influences growth of cell, cells grow within a well-defined temperature grow range. This

growth range is defined by a minimum temperature below which cells are metabolically inactive and a maximum temperature above which cells do not grow. Within this range of extremes is an optimal growth temperature at which cells exhibit their highest rates of growth and reproduction.

Metabolic pathways speed dawn with the increase of temperature to extent point that after whole metabolic cease because of cellular macromolecules irreversibly denatured especially proteins, enzyme that affected the microbial growth which is a yield of metabolic pathways and its affect directly with temperature.

Metabolic enzymes since each enzyme has its own optimum, maximum and minimum temperature , so temperature less than optimum decrease the molecular motion and other physiological functions especially cytoplasmic membrane due to the solidification of lipids and increase of viscosity of proteins resulting in decreasing in enzymatic activity and stop working but does not denatured (reversible effect) that's why many biological preparation preserved at low temp. (freezing) such as: protein , enzyme , viruses…..etc as lyophilic form.

Temperature over than optimum result in increase in the rate of enzymatic activities and irreversible denaturation occurs due to breakage of hydrogen bonds and scattering the secondary and tertiary arrangement of protein plus DNA melting.

Temperature coefficient (Q 10):

Scientists have evaluated the effect of heat on biological activities including growth (the yield of all metabolic activities in the cell) by heat equivalent speed of reaction of any metabolic process in specific temp. in comparison with its speed in temp. 10 times less than that one

$$Q_{10} = \frac{K_t + 10}{K_{t2}}$$

At room temp. $(18\text{-}25)c° \rightarrow$ .Q_{10} is about (-3-4) and decrease when temp. increase.

Kt + 10° C (Constant of growth speed at a temperature above 10° C)
Kt (Constant of growth speed at a temperature)

For example : Kt at 27° C = 0.317
                Kt at 37°C = 0.891

Q10= Kt at 37° C /Kt at 27° C
     = 0.891 /0.317

If Q$_{10}$ > 1 $\longrightarrow$ growth increase when temp. increase.

If Q$_{10}$< 1 $\longrightarrow$ growth decrease when temp. increase.

If Q$_{10}$=1 $\longrightarrow$ temp. has no effect on growth.

To calculate constant value of the growth speed (Kt) use

Kt=log NT – log No /t * 0.301

No = the number of cells at the experiment start .

NT = the number of cells after passage time of experiment .

T = time of experiment .

Log 2 = 0.301

Can calculate constant value of the growth speed (Kt) by use
generation time value according to the equation :

Gt=1/Kt ,   Kt=1/Gt

Redaction time (Rt):

When bacteria are exposed to a large and sudden increase in temperature ,
which leads to a decrease in their number in certain time and be (T) is the
time of the bacteria are exposed to high temperature , the account
reduction time =

Rt = t/log a – log b

a=the number of cells before exposure to high heat .

b= the number of cells after exposure to high temperature and the occutencedecreases .

t= Time that bacteria exposed it to high heat .

Procedure of temperature :-

1-Serial dilution are prepared from *E.coli* bacteria cultivate on nutrient broth at a temperature of 37 °C for 24 hours.

2-Using 0.1 ml from third diluted on nutrient agar media, and spreader is uses to bacteria spreading on the plate , and incubated at a temperature of 37 °C for 24 hours.

3-Taken third diluted and exposure to temperature to be the study of their effect on growth of bacteria for a half hour, later transferred 0.1 ml of this tube into plate contains nutrient agar are cultivated in a spread method to count of the growing bacteria at this temperature after a incubation needed for growth (37 °C for 24 hours).

4-Tube exposure above to another temperature are different with 10°C from the previous degree , later transferred 0.1 ml of this tube into plate contains nutrient agar are cultivated in a spread method to count of the growing bacteria at this temperature after a incubation needed for growth. To find a temperature coefficient(Q 10) and knowledge of studied the effect of temperature on growth.

2- Chemical factors

Includes use CO_2 and the use of nitrogen, sulfur and phosphate sources, rare elements such as Mg and Fe and includes the presence or absence of oxygen.