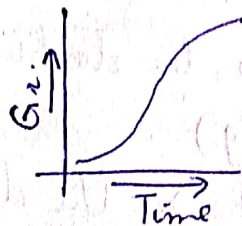
Microbial Growth & Nutrition

1. It is a vital process.
2. Cause increase in size, number, form, weight, volume etc.
3. It is a permanent change also.

Phases of growth → a) Cell Formation → Slow (growth rate)
b) Cell elongation / increase (Rapid) Grand period.
c) Cell differentiation. Steady (Maturity)

Growth curve



S- shaped.

sigmoid.

Measurement (i) Yard Stick, (ii) Tape, (iii) Horizontal Microscope
(iv) Auxanometer, a) Arc, b) Pfeffer's automatic auxanometer.
(v) Bose's crescograph (vi) Space marker disc.

Factors Affecting Growth:

(i) Food Supply — Nutrients.
(ii) Water Supply
(iii) Oxygen Supply
(iv) Temperature
(v) Light < Intensity, Quality, Duration
(vi) Growth hormones.

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⇒ In microbes growth means increase in cell number or size.
Generally they multiply by binary fission.
1stly the cell increases in size ~~such the~~ upto double
Then devides into daughter cells approximately the same size as original mother cell.

⇒ The growth rate measures change in either cell number or cell mass per unit time.

The time required for the doubling of cell numbers is known as generation time. (g)

The time required for the doubling of cell mass is known as Doubling time. (t_d)

The growth rate, (v) is the number of doubling of cell number per hour $= 1/g$. It is reciprocal value of generation time.

Measurement: [A] **Number**: In a bacterial population some cell are viable, & some are not viable.

(i) **Total cell count**:- All visible cells are counted, viable as well as non-viable and damaged ones.

The most widely used method is enumeration with the help of microscope of the numbers of cells suspended in a thin agar layer or, definite volume, placed in a counting chamber (of known volume)

→ Neubauer or Thoma.

Volume is about (5×10^{-8} c.m^3). Layer is about 0.02 mm deep and an area 0.05 mm square.

The number of cells counted in the square must be multiplied with 2×10^7 gives the total number of cells/ml.

$N = n \times 2 \times 10^7$.

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(2) Coulter counter → It is an electronic instrument, based on the principle of — loss of conductance of an electrolyte solution which occurs when small particle (organisms) passes through a narrow orifice.

(3) Membrane filteration method :- Known volume of solution containing microbes is filtered through the membrane filter — Then dried, stained, made transparent for microscopic enumeration of the cells on the filter (known area there of).

Note:- It is done mainly in the case where number of cells is below 10^6/ml).

[B] Mass :- (i) Wet mass or Dry (mass) weight is common.
(ii) Protein quantity.
(iii) Nitrogen content
for metabolic and enzyme activities.

(a) Direct Methods:- (i) After centrifugation (wet) weight is taken
(ii) After drying centrifuged cells till a constancy of weight
→ Both of these may possess certain systematic errors
(iii) Total nitrogen content (by micro - Kjeldahl with micro - diffusion of ammonia).
(iv) Total carbon (by van - Slyke Folch) can be more accurately determined.
(v) Protein estimation →
By modification of Biuret reaction and calorimetrically accessible colour reactions are much in use.

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(vi) Micromethods → Lowry or Folin Ciocalteu methods.)

Indirect methods:- (i) By measurement of turbidity of cell suspension

- Usually optical density or turbidity of a suspension is measured as extinction.

Nephelometry may be more accurate.

Note:- It is limited to a limited range of cell concentrations. due to

- Scattering of cells ~~by~~ is influenced by size, (diameter), shape, refractive index, turgor, composition of cell.

(II) (i) Oxygen uptake,

(ii) CO_2 production,

(iii) Acid production:

Monometric
Titrimetric
Electrochemical methods may be used

Note:- All the indirect methods ~~are~~ need to be calibrated to direct measurement by dry weight.

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