Growth Curve Parameters

There is growth in culture.

In a batch culture there is growth.

It may be followed by means of dry weight determination

The growth parameters of primary interest are

a) Yield,
b) Exponential growth rate, and
c) The duration of lag phase.

a) **Yield**:- The difference between final and initial mass is known as Yield $X = X_{max} - X_0$

It is expressed in dry weight

There is a relationship in the yield and consumption of substrate $\boxed{X/S}$. When both of these are expressed in unit of weight X/S is known as Yield co-efficient or growth Yield and denoted by Y.

The yield is also related to the concentration of substrate and calculated as the molar growth yield Y_m (g cells/ mol substrate) (the Yield)

Y_m enables us to relate it with the amount of ATP available from metabolism of a given energy source (Substrate).

It leads to an energy yield co-efficient (g cells/mol$_{ATP}$) which can be calculated when the catabolic pathway and its energy yield for a substrate is known.

The values of Y_{ATP} has been determined.

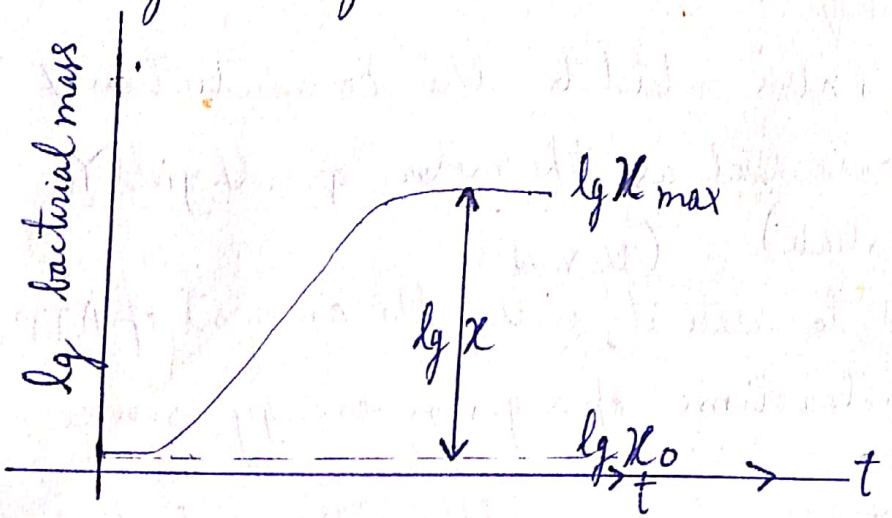
— For anaerobic cultures of E. coli and Klebsiella pneumoniae the growth rate is limited by the supply of glucose, Respective Y_{ATP} values of 12·4 and 14 g cells/mol ATP have been determined.

Y_{ATP} is a largely constant value in an anaerobic bacteria which obtain its total energy by fermentation.

If for a new bacterium Y_{ATP} value is higher, it suggests additional energy yielding metabolism.

— For aerobic bacteria Y_{ATP} value do seems to depend on the growth conditions and necessary synthetic activities of cells. i.e.

Whether the nitrgen source for the cell synthesis is in the form of ammonium ions, nitrat ions, or organic nitrgen compounds.



Yield

Growth Parameter Yield.

Exponential Growth Rate: The measure of the speed of cellular growth in the exponential phase is known as Exponential Growth rate.

It is calculated $$\mu = \frac{\log x_t - \log x_0}{\log e (t - t_0)} = \frac{\ln x_t - \ln x_0}{(t - t_0)}$$

[Here x_0 = Bacterial concentration at the time t_0 (Initial time)
x_t = " " " " t (Final time)]

$\log e = 0.43429$.

The doubling time $t_d = \frac{\ln 2}{\mu}$.

The lag phase: It is the time interval between inoculation and establisment of the maximum division rate.

Its actual duration depends on
- The previous culture history
- The age of culture.
- The composition and stability of the nutrient medium.

It is also an important parameter for judging the properties of an organism and the suitability of a medium.

$$T_l = t_r - t_i = t_r - \frac{\ln x_r - \ln x_0}{\mu}$$

[l = lag phase
r = real growth
i = ideal growth]

The lag period T_l is the time interval between the time t_r at which the culture has reached a certain density x_r and the time t_i at which it would have reached the same density if it had been growing exponentially from the time of inoculation.

The parameter T_i can be used when two cultures with same exponential growth rates are compared.

The lag period is usually expressed in the terms of generation time (g) rather than in absolute time.

The difference between the observed, real growth and ideal growth, expressed in multiples of generation time is L

$$L = T_i \cdot v.$$

The L value therefore states by how many doublings the real culture lags behind the ideal culture that would have grown at the exponential rate throughout.

These L values are used in comparisons of data of growth the influence of → different nutrients,
→ inhibitors and
→ environmental conditions.