NAME Chap.5. 박정규 2013

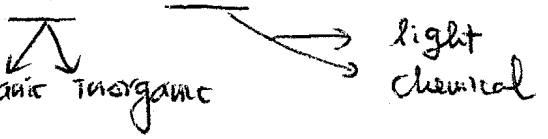
SEOUL NATIONAL UNIVERSITY

Mannahan, chapter 6

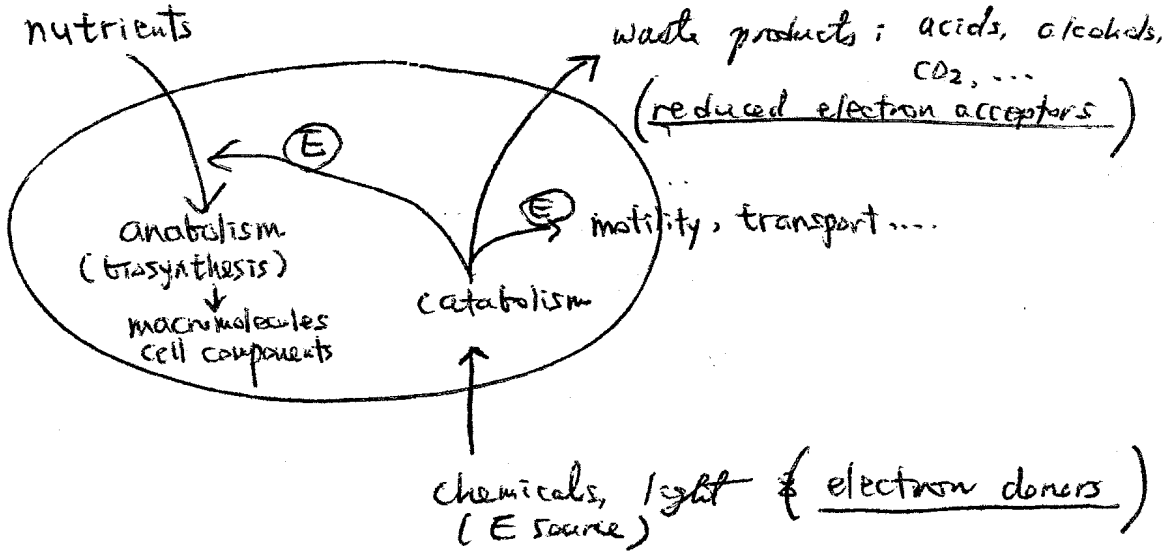
<Microbiological Chemistry>

- microorganisms : prokaryotes and eukaryotes

- classification based on C and E sources



① chemoheterotrophs : chemical Ⓔ + org Ⓒ
② chemo autotrophs : 〃 + inorg Ⓒ (CO_2, HCO_3^- ...
③ photoheterotrophs : photo Ⓔ + org Ⓒ
④ photoautotrophs : photo Ⓔ + inorg Ⓒ



- m/os tend to grow at interfaces

(e.g.) - attached on solid surfaces which are suspended.
- free floating m/os
- attached on non-moving matrices.

1) algae. (consider unicellar algae only)

① Inorganic Ⓒ + hν → organic Ⓒ + O_2(g).

; $CO_2 + H_2O \xrightarrow{h\nu} (CH_2O) + O_2$(g).

② In the absence of light, algae consume O_2

→ O_2 depletion may occur.

③ production of biomass (from Inorganic Ⓒ) and O_2

2) fungi

① nonphotosynthetic, often filamentous

② aerobic

③ (cellulose / lignin) degradation (cellulase / lignin peroxidase...)

3) Protozoa

① animals

② some contain chloroplasts → photosynthetic.

③ feed on bacterial cells.

4) Bacteria

① mostly 0.5~3 μm

② tremedous metabolic activity

ⓘ surface-to-volume ratio is extremely large.

✱ aerobic vs. anaerobic respiration (in bacteria)

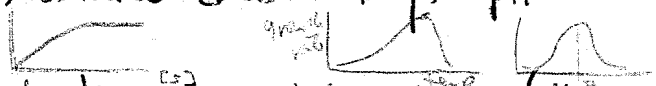
; distinguished by terminal electron acceptor.

if O_2 : aerobic

if not : anaerobic. (SO_4^{2-}, NO_3^-, HCO_3^-, Fe^{3+}...)

psychrophiles < 20°C
mesophiles 20~45°C thermophiles > 45°C

③ substrate conc. temp. pH ...



✱ cyanobacteria ; photosynthetic ($H_2O \rightarrow O_2$), formly blue-green algae

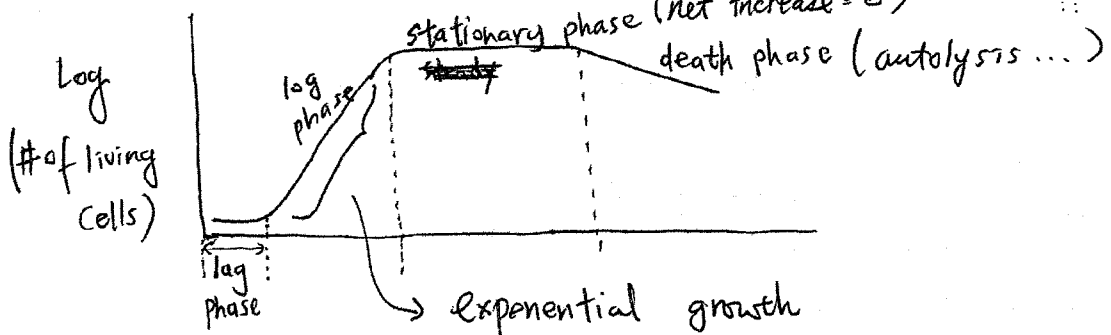
(have chlorophylla)

- autotrophic : - not dependent on org. matter for growth
  - use CO_2, carbonate species as a C source
- heterotrophic : - dominant
  - pollutants-degrading.

< Bacterial growth >

※ growth : an increase in the number of cells (population growth)

→ doubling (generation) time.



$N = N_0 \cdot 2^n$ (n: # of generations)

g (generation time) $= \frac{t}{n}$ (t: hours (min) of exp. growth)

$\log N = \log N_0 + n \log 2$

$\therefore n = \frac{\log N - \log N_0}{0.301}$

(differential equation)

$\frac{dX}{dt} = \mu X$ (X: cell #, μ: instantaneous growth rate constant)

$\ln X = \ln X_0 + \mu \cdot t$

$X = X_0 e^{\mu t}$

(X: cell # at time t, t: elapsed time during which growth is measured)

doubling of population occurs when $X/X_0 = 2$

$2 = e^{\mu(t_g)}$ (t_g: generation time)

$$\mu = \frac{\ln 2}{t_g} = \frac{0.693}{t_g}$$

$$\frac{1}{t_g} = k \quad \text{(growth-rate constant) for a batch culture}$$

k: doublings / t

$$\therefore \boxed{\mu = 0.693k}$$

$X = X_0 \cdot e^{\mu t}$; take log and substitute μ w/ $0.693k$

$$\log X = \log X_0 + (0.693k) \cdot t \cdot \log e$$

$$\therefore k = \frac{\log X - \log X_0}{0.301\,t}$$

(*) μ and k → "average value for a population over a finite period of time" (for a batch culture)

↓ (manipulated in continuous culture)

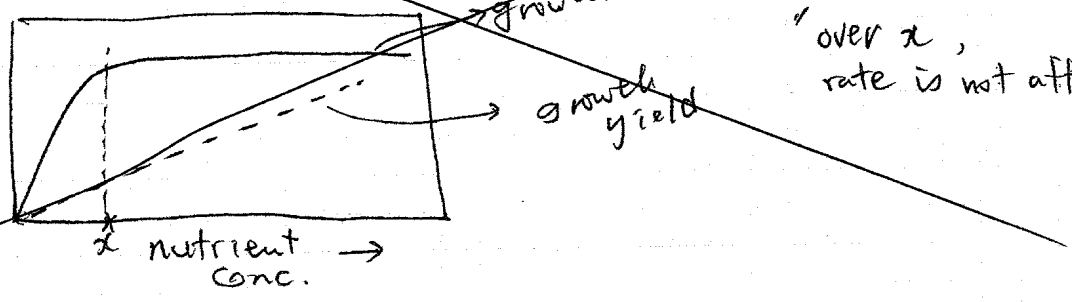
use approximation of the rate at which individual activities are occurring.

(bacterial growth dynamics in a theoretical framework)

< Chemostat >

- continuous culture device
- able to control population density and growth rate

(X) batch culture



"over x, rate is not affected."