1.89, Environmental Microbiology
Prof. Martin Polz
Lecture 11

Peripheral Metabolism

- Difference between aerobes & anaerobes
- Difference in flexibility of C-substrate use.
  Example: Pseudomonas Putida: > 200 different C-substrates
  Bacillus Fastidiosus: 1 C-substrate (uric acid)
- Over 20 million known C-substrates (primarily products of plants & bacteria)
- Dominance of polymers (because what organisms are composed of)

1. Polymers

Problem → large & insoluble

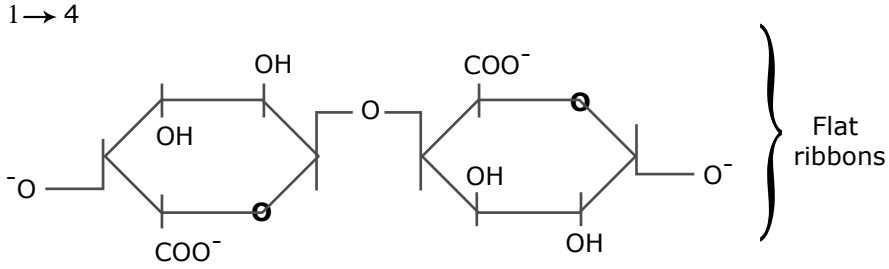
involved in → motility & attachment (gain access to polymers by…)

→ extracellular degradation via excretion of hydrolytic enzyme

→ monomers: uptake

a) Polysaccharides: structure & storage
   example: cellulose

Glucose β 1 → 4



- Enzymes
  - Endoglucanases
  - Exoglucanases

  } cellulases

- Other enzymes
  - Chitinases
  - Pectinases
  - Xylanases

b) Lignin
   Secondary component of wood
   - Many aromatic rings
   - Large & irregular structure

- Role is protection from biodegradation
  phenolic rings are toxic, & structural irregularity makes it hard to degrade
- Oxygenases catalyze initial biodegradation (ring oxidation) of phenolic rings

c) Humics
- Conglomerate of organic compounds
- Product of chemical & biological degradation
  core: aromatic rings
  Condense with reactive residues (carboxylic acid groups or amino groups) to form very large & insoluble molecules
- Soils & sediments
- Turnover in temperate soils ~ thousands of years

d) Other polymers
- Proteins → proteinases (degrade proteins)
- DNA, RNA → nucleases (degrade nucleotides)

2. <u>Monomers</u>

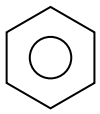
a) Amino acids deamination → enter TCA cycle, glycolysis
example: aspartate → oxaloacetate
alanine → pyruvate

b) Organic acids
- 2, 3 C → glyoxylate cycle
- 4-6 C → TCA
- >6 C → β oxidation

c) Hydrocarbons
- C & H only → most reduced form
- Poorly soluble
- All organisms make some, but they are mostly a product of diagenesis (oil)

Aliphatics = straight or branched chains

<u>Oxygenases degrade them</u> most effectively: enzymes that directly incorporate O into the carbon chain ⇒ primarily <u>aerobic hydrocarbon degradation</u>

Aromatics = rings  → Also degraded by <u>oxygenases</u>
(basic structure)

Oxygenases:
Monoxygenases: incorporate O
Dioxygenases: incorporate O_2

Anaerobic: activation with CoA via ATP expenditure

- Common intermediate = benzoyl CoA
- Much less efficient than aerobic degradation
- Can degrade small hydrocarbons