

فسيولوجيا الأحياء الدقيقة Microbial Physiology

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مكتب ٢ ب ٤٥

مقدمة
Introduction-L3

Cell Structure and Function

- **Flagella:** Organisms have to adapt to the environmental niche conditions.
- The bacterial movement is directed by many different strategies:
 - ❖ **Chemotaxis:**
 - Movement towards beneficial chemicals (attractants).
 - Movement away from harmful chemicals (repellents).
 - ❖ **Phototaxis:**
 - Light.
 - ❖ **Oxytaxis:**
 - Oxygen.

Cell Structure and Function

- Most bacterial movement is mediated by flagella:
 - The flagella consists of a basal body, hook and filament.
 - Movement is achieved by rotation of flagella.

- **Pili and Fimbriae:**
 - ❖ **Pili:**
 - 1-2 per cell.
 - Involved in DNA transfer (conjugation).

 - ❖ **Fimbriae:**
 - More numerous.
 - Involved in attachment.

Cell Structure and Function

- **Inclusions:**

- Found in the cytoplasm with many different types:

- ❖ **Metachromatic granules:**

- Generally volutin (a polyphosphate).
 - The main function is to supply phosphate for nucleic acids synthesis, cell division, energy metabolism, and others.

- ❖ **Polyglucan granules:**

- Known also iodophilic or polysaccharide.
 - Stained by iodine solution (brown or bluish under light microscope).
 - Deposited by the bacterial cell when simple sugars present for glucan synthesis.
 - Important source for Carbohydrate metabolism during starvation.
 - Found in Clostridia and Coliform bacteria.

Cell Structure and Function

- **Inclusions:**

- Found in the cytoplasm with many different types:

- ❖ **Poly-beta-hydroxybutyrate (PHB) granules:**

- Also known as sudanophilic (stained by lipid stain sudan black B or Nile blue) or Lipid granules.
 - Formed during lipid synthesis and acetate metabolism.
 - Found in *Bacillus* species and other soil bacteria.

- ❖ **Sulfur globules (crystals):**

- Found in bacteria growing in rich environments with hydrogen sulfide (H_2S) gas such as hydrothermal vents, thermal geysers, boiling water, or sulfur spring.

- ❖ **Gas vacuoles:**

- Found in Aquatic microbes as protein buoyancy.
 - Impermeable to water, but allow exchange of various gases.

Cell Structure and Function

- **Endospores:**

- ❖ Not produced by all bacteria:

- Only members within the Gram-Positive group.
 - Spores are formed as survival mechanism.
 - A morphological change as a result of severe conditions:
 - ✓ Increased temperature.
 - ✓ Decreased substrate availability.
 - ✓ End-products build up.
 - The endospore can tolerate harsh environments until they become more appropriate.

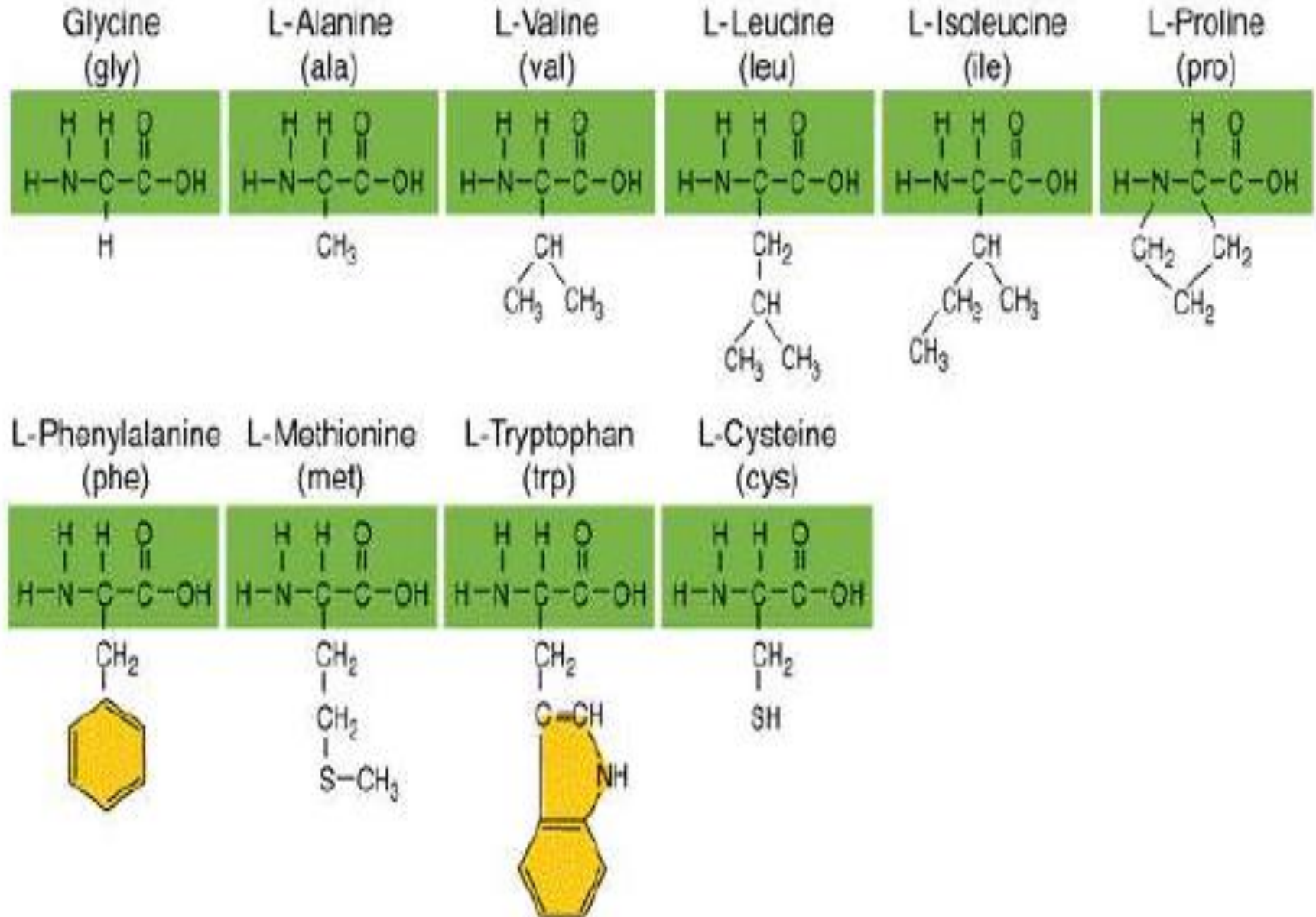
Structures of Proteins

- The building blocks of proteins are “**Amino Acids**”.
- Amino Acids are classed according to their nature into:
Aliphatic, Cyclic, Aromatic, Basic, Acidic and **Hydroxyl** or **Sulfur** containing side-chains.
- **Aliphatic** R groups are nonpolar and hydrophobic.
alanine and **glycine** are ambivalent (inside or outside the protein molecule).
- **Proline** is the only **cyclic** amino acid. It shares many properties with the aliphatic group. Also, **proline** is one of the ambivalent amino acids.
- **Aromatic** amino acids have unique and important properties. **Phenylalanine, tyrosine**, and **tryptophan** are generally hydrophobic.

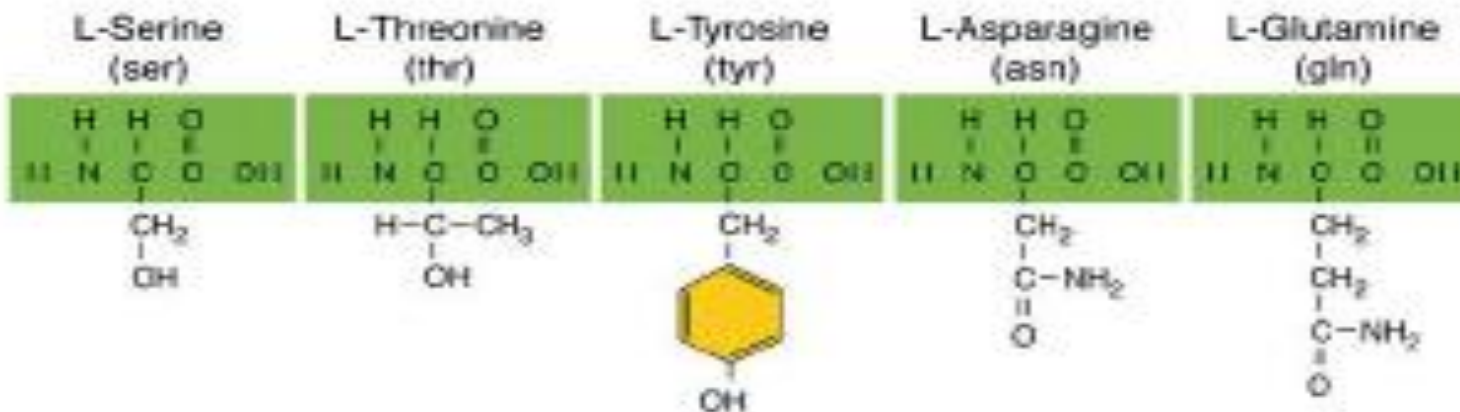
Structures of Proteins

- There are three amino acids that have **basic** side chains at neutral pH. These are **arginine**, **lysine**, and **histidine**. Their side chains contain nitrogen and resemble ammonia, which is a base.
- Two amino acids have **acidic** side chains at neutral pH. These are **aspartic acid** or **aspartate** and **glutamic acid** or **glutamate**. Their side chains have carboxylic acid groups.
- **Hydroxyl** amino acids are polar, uncharged at physiological pH, and hydrophilic (**serine** and **threonine**).
- **Methionine** and **cysteine** are the common **sulfur**-containing amino acids.

1. Hydrophobic or nonpolar side groups

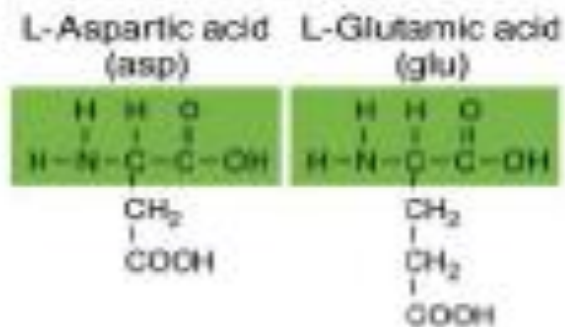


2. Hydrophilic or polar side groups

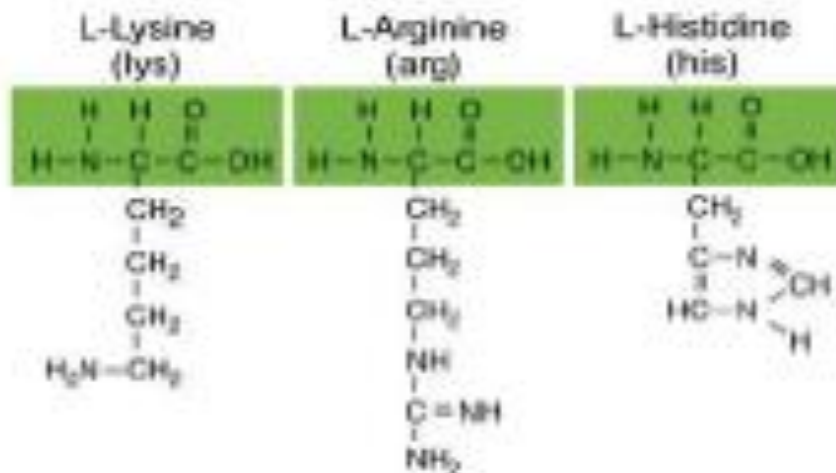


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3. Acidic side groups



4. Basic side groups



Proteins secretion & Lipids

- A large amount of the proteins produced intra-cellularly are involved in some way with the cell membrane or wall.
- Some proteins are secreted to digest large macromolecules.
- **Lipids:**
 - Involved in biological systems.
 - Have the general shape of a polar head with a hydrophobic hydrocarbon chain.
 - The hydrocarbon chain is saturated with hydrogen atoms when no double bonds present between the carbon atoms.
 - Double bonds present, the lipid is said to be unsaturated (e.g. mono and polyunsaturated fats in oils and margarines).

Lipids

▪ Lipids:

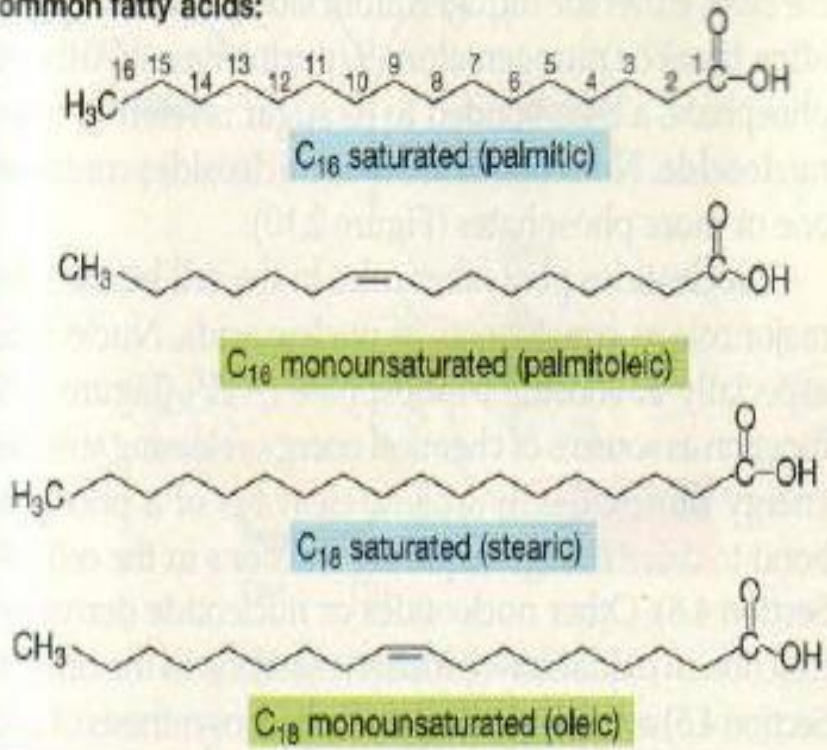
- Simple lipids (triglycerides)- three fatty acids linked to glycerol.
- Hydrophobic hydrocarbon chain.
- Saturated (with H atoms) chains are straight with no C=C.
- Unsaturated chains have "kinks" (has C=C) and less stable.

❖ **Fatty acids**- the simplest biological lipid.

❖ **Phospholipid:**

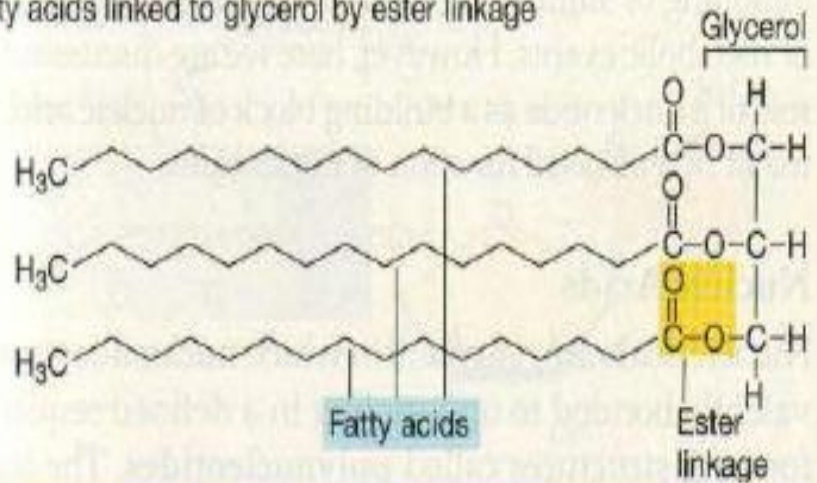
- The main lipid-like structure found in biological systems.
- Constructed from two hydrophobic hydrocarbon chains connected to a phosphate poplar head.

Common fatty acids:



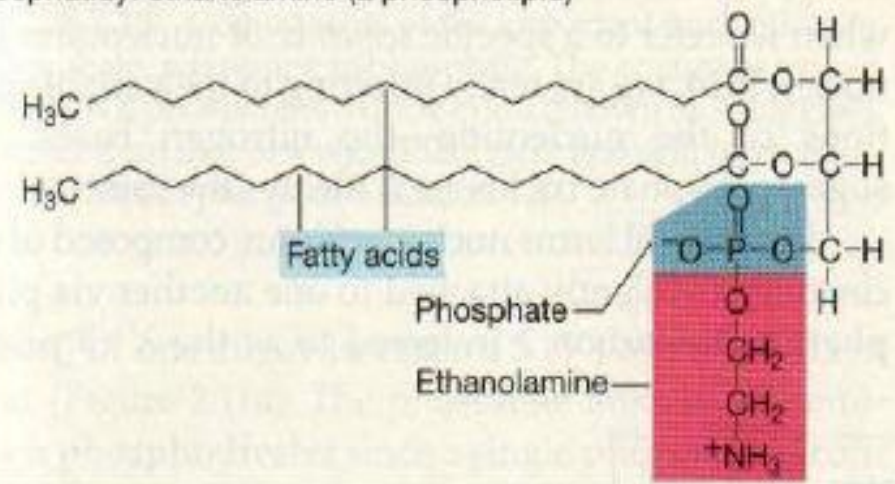
Simple lipids (triglycerides):

Fatty acids linked to glycerol by ester linkage



Complex lipid:

Phosphatidyl ethanolamine (a phospholipid)



Complex lipid:

Monogalactosyl diglyceride (a glycolipid)

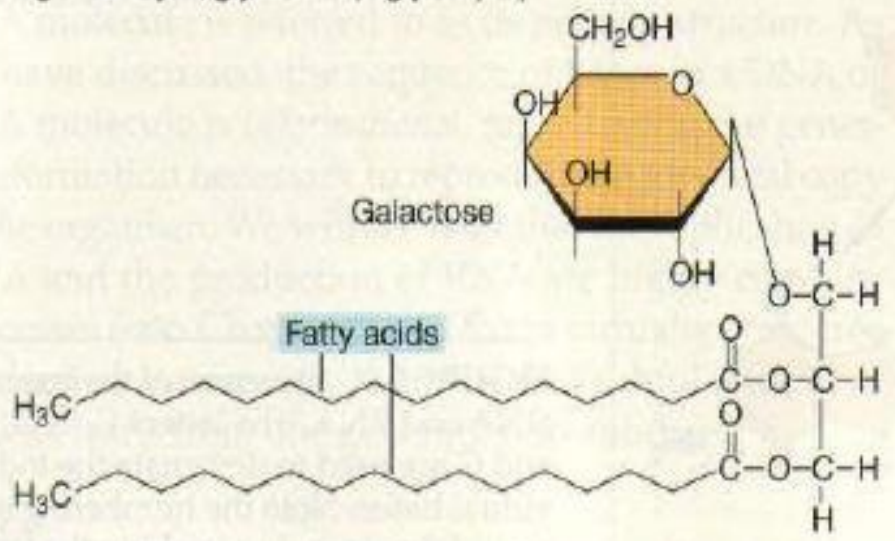


FIGURE 2.7 Fatty acids, simple lipids (fats), and complex lipids. Simple lipids are formed by a dehydration reaction between fatty acids and glycerol to yield the ester linkage.

QUESTIONS??

