THIRD CHAPTER: Structure and physicochemical properties of lipids

(Part 2)

IV.1. Glycerides

Glycerides are esters formed from glycerol and fatty acids, they constitute 90% of the lipids in adipose tissue. Glycerol is a trialcohol with three esterification positions (1,2,3) or (α,β,ά).

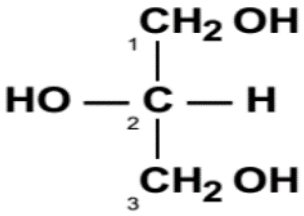
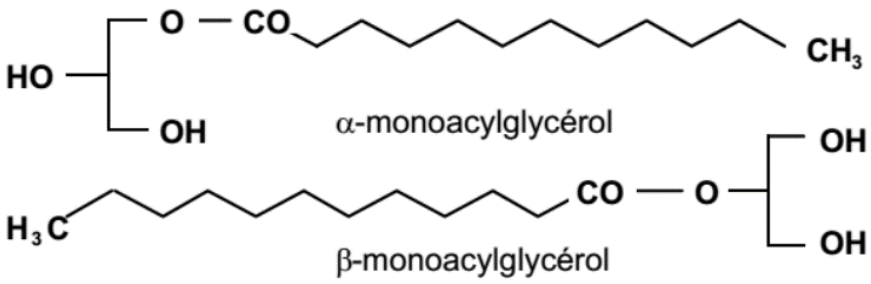


Fig.7 Structure of glycerol.

The nomenclature of glycerides is based on 2 criteria:

1) **Nature of fatty acids:**
   - **Homogeneous glyceride:** the esterifying fatty acids are of the same type.
   - **Heterogeneous glycerides:** composed of several types of fatty acids.
2) **Number and positions of esterifications:** Glycerol has three hydroxyl functional groups, which can be esterified with one, two, or three fatty acids to form:
   - **Monoglyceride:** esterification of a single alcohol function;
   - **Diglyceride:** esterification of two alcohol functions;
   - **Triglyceride:** esterification of the three alcohol functions

a. Les monoglycérides



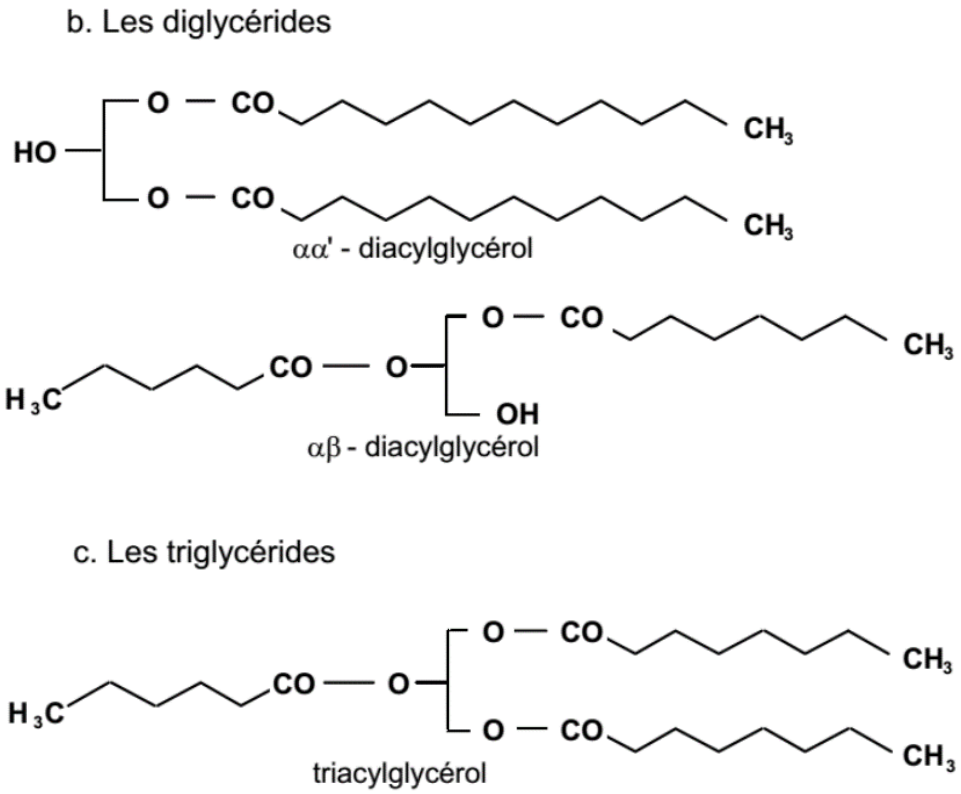


Fig 8. Types of glycerides.

IV.2. Physicochemical properties of glycerides:

a. Physical properties

- **Solubility:** they are insoluble in water and very soluble in non-polar solvents such as (ether, benzene, chloroform), hot alcohol and in acetone.
- **The melting point:** it depends on the nature of the FA; it is lowered when the quantity of unsaturated FA increases.

b. Chemical properties

- Hydrolysis of glycerides into glycerol and FA (chemical by acids or enzymatic).
- Saponification: corresponds to the cutting of ester bonds by the action of soda or potash, hot with release of glycerol and FA in the form of soap.

IV.3. Cerides

They are high molecular weight fatty acid and alcohol esters. They have a high melting point (80°C), are insoluble in water and soluble (hot only) in organic solvents.

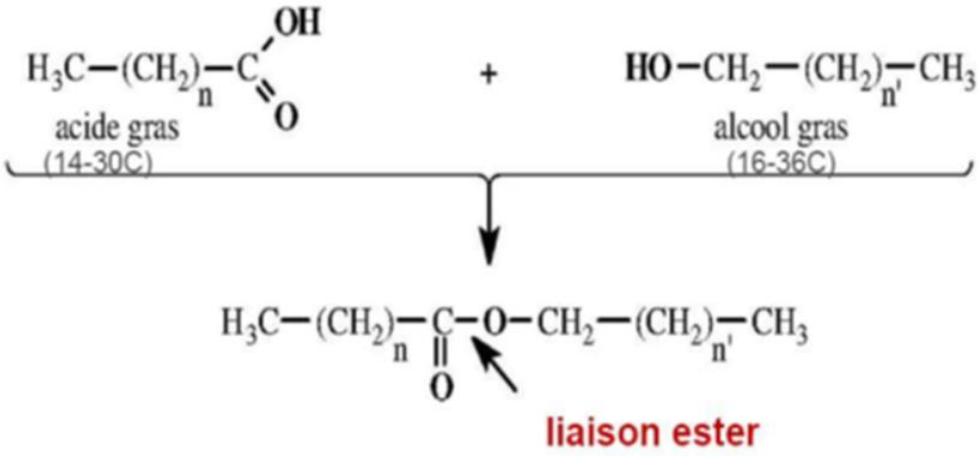


Fig 9. Structure of cerids.

Cerides generally have a protective covering role, rarely a reserve role, depending on the species.

VI.4. Steroids

They come from the esterification of fatty acids by sterols (tetracyclic alcohols carry methylated substituents). The main representative of sterols of animal origin is cholesterol.

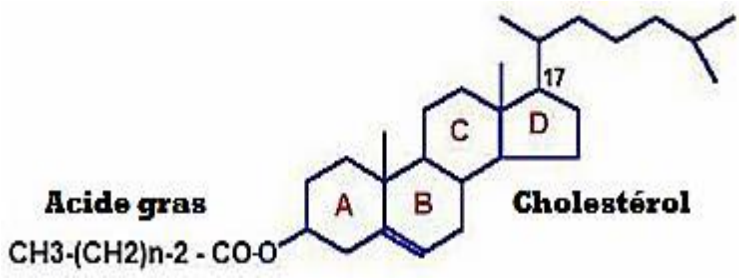


Fig 10. Chemical Structure of steride.

Example: Cholesteryl palmitate.

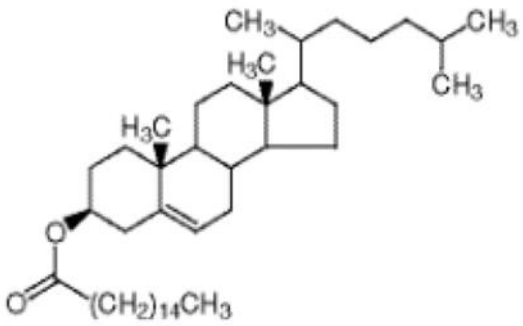


Fig 11. Chemical Structure of cholesteryl palmitate.

I. Complex lipids

They are heterolipids which contain, in addition to the elements C, H, O, phosphorus (P), nitrogen (N) or sulfur (S). They are made up of an alcohol which binds a fatty acid and/or other compounds. They can be classified according to alcohol:

- Either glycerol: we distinguish: Glycerophospholipids (Phosphorus) and glycero glycolipids (sugar);
- Either an amino alcohol: sphingosine which defines sphingolipids.

They are amphiphilic molecules because they have both a polar alcohol function and a nonpolar hydrocarbon chain. Complex lipids are the essential constituents of biological membranes (Figure 14). On the other hand, they have no energetic role.

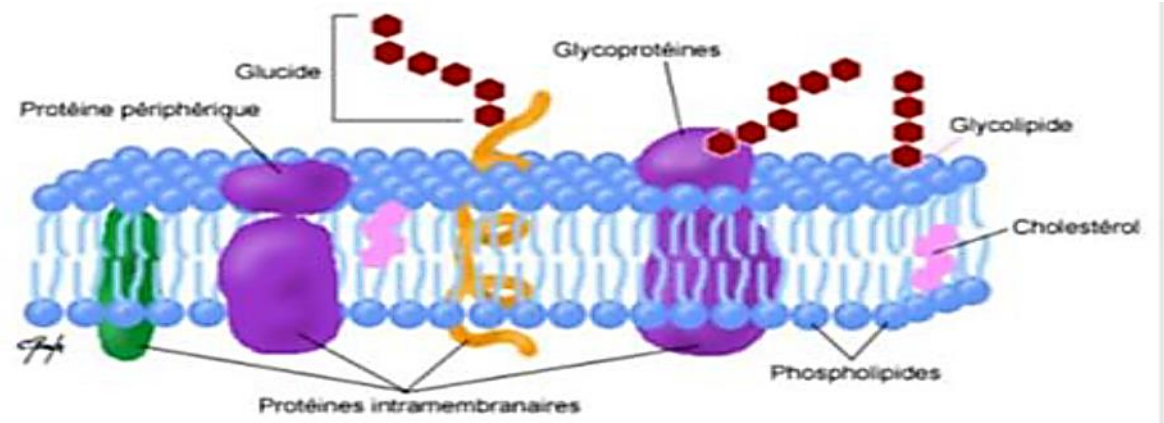


Fig 12. The composition of biological membranes.

V.1. Structure and properties of glycerophospholipids

Phospholipids or glycerophospholipids are lipid compounds containing phosphorus. These are the main constituents of biological membranes, they naturally tend to organize themselves in a double layer.

They are made up of a glycerol molecule on which two fatty acids are esterified, the third function is esterified by a phosphoric acid molecule.

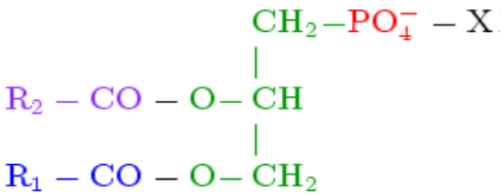


Fig 13. General formula of a glycerophospholipid.

Phosphatidic acid is the basic element of glycerophospholipids.

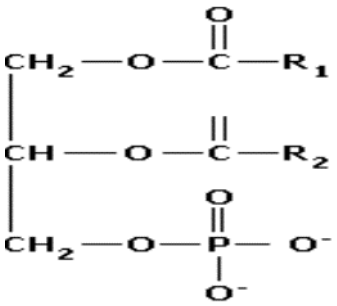


Fig 14. Structure of a phosphatidic acid.

The esterification of phosphatidic acid at the level of its phosphoric group by an alcohol gives rise to glycerophospholipids, there are 04 types depending on the nature of the alcohol involved:

- **Phosphatidylserines:** Phosphatidic Acids + Serine
- **Phosphatidylethanolamines:** Phosphatidic Acids + Ethanolamine
- **Phosphatidylcholines (lecithins):** Phosphatidic Acids + Choline
- **Phosphatidylinositols:** Phosphatidic Acids + Inositol

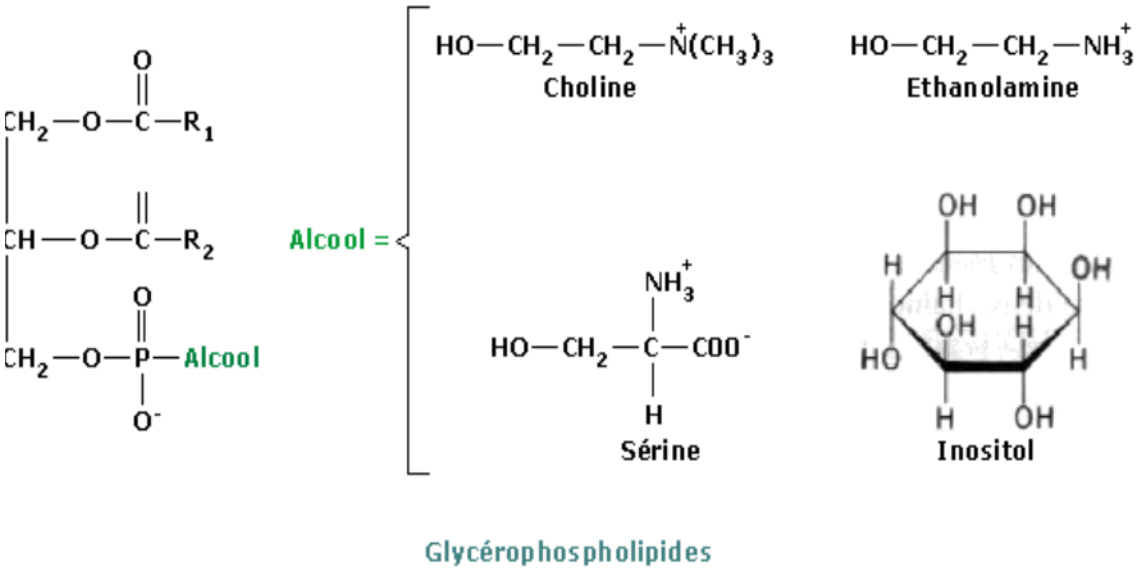


Fig 15. Formulas of glycerophospholipids.