



LIPIDS

Lipids: are found in all organism as structure components of the cell membrane, lipids are naturally occurring compounds that are esters of long chain fatty acid . defined also as compounds which are relatively insoluble in water, but freely soluble in non-polar organic solvent like benzene, chloroform, ether, hot alcohol, acetone, etc , although triglycerides are not important lipids , they are stored in most animal and plants as a metabolic energy reserve . In vertebrates , TG is located in an adipose (fat) tissue , which is widely distributed in the body

CLASSIFICATION OF LIPIDS

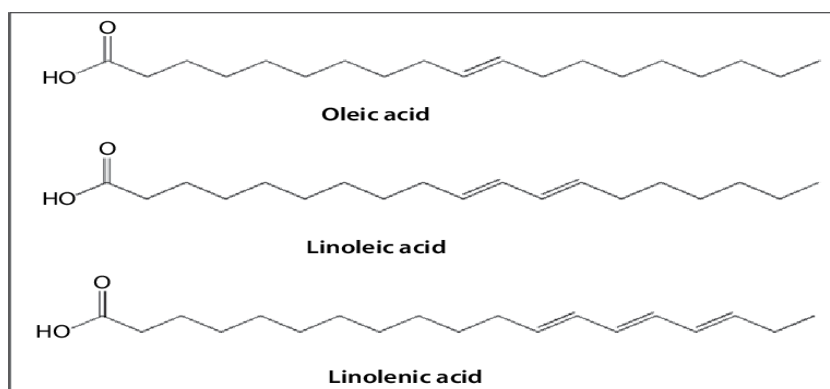
- 1- open chain compounds (saponifiable)
 - a) fatty acids
 - b) triglycerides
 - c) phospholipids
 - d) sphingolipids
 - e) waxes
- 2- closed chain (non-saponifiable)
 - a) cholesterol
 - b) steroids
 - c) derived



FATTY ACIDS

they are carboxylic acid that occurs in natural triglyceride (TG) , ranging in chain length from C₄-C₂₄ fatty acids classified into following types:

- 1- saturated fatty acids which are contain no double bond
general formula C_nH_{2n+1}COOH ex. CH₃(CH₂)₁₆COOH stearic acid.
- 2- Unsaturated fatty acids which are classified further according to the degree of unsaturation
 - a) Mono unsaturated fatty acid , one double bond in the carbone chain
 - b) Poly unsaturated fatty acid, two or more double bonds in the carbon chain



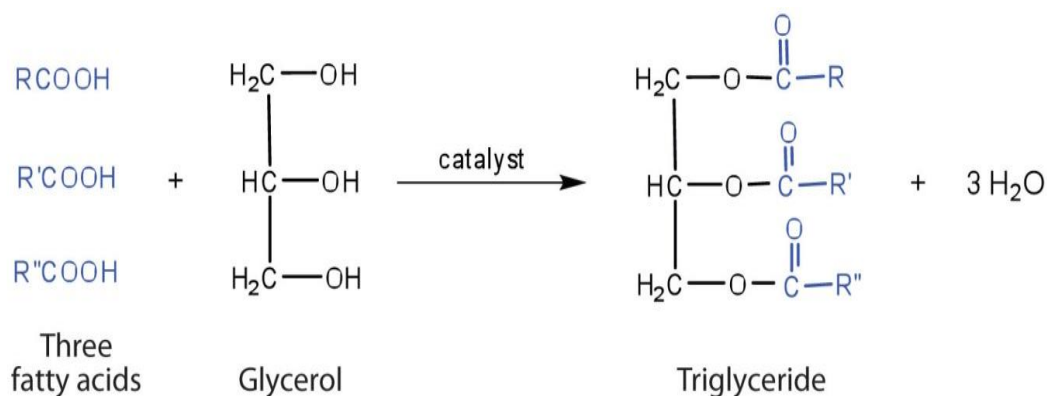
Triglycerides can be called fats or oils , depending upon the degree of unsaturation in the compound , the ways for distinguishing between fats and oils are physical properties and structural formulas.



The physical distinction is that fats are solid at room temperature and oils are generally liquid at room temperature. The structural difference is that fats are saturated (they have single bonds between all the carbon atoms) and oils are unsaturated (they contain some double bonds between carbon atoms) . A third common distinction in those fats comes from animals and oils come from vegetables , these distinction are generalities and there are exceptions.

OILS AND FATS

oils and fats are triglycerides or triesters which are formed by the reaction of fatty acids with glycerol, which has three alcohol groups . glycerol is also called 1.2.3. propantriol.



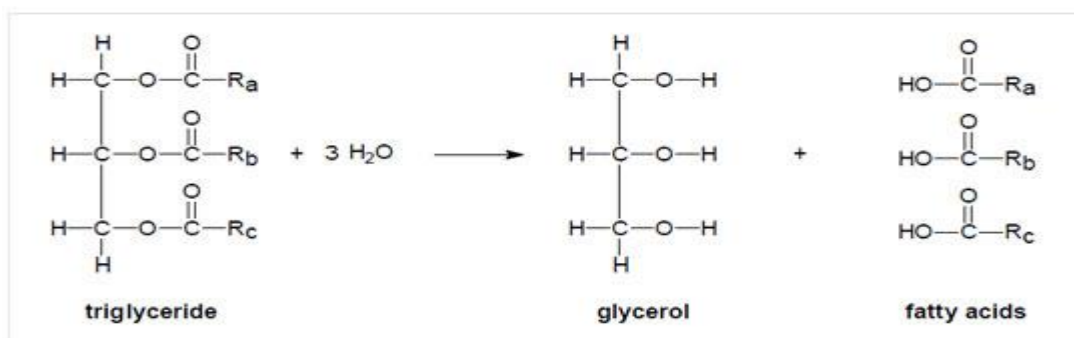
Reactions of fatty acids

A- Hydrolysis

The reverse process of the formation of esters can also occur that process involves the addition of water to an ester to



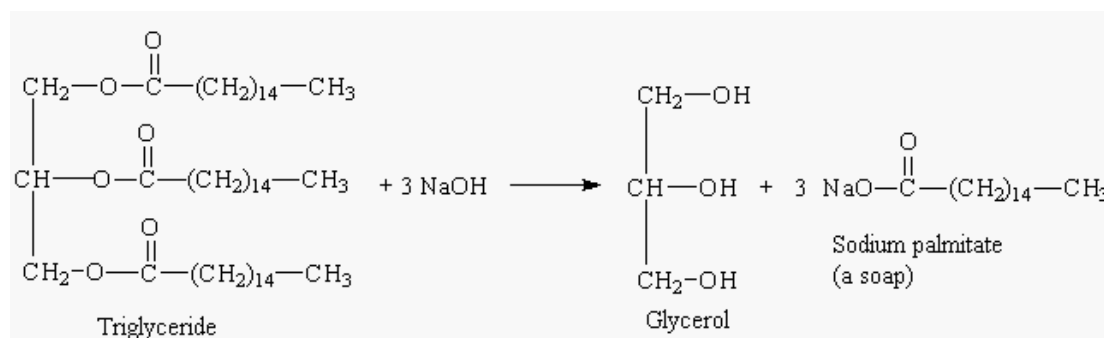
reform the acids and the alcohols that went into making the ester such as reaction is referred to as hydrolysis



B- Saponification.

This Kind of hydrolysis can also be carried out in the presence of a strong base like NaOH , the acids formed by the hydrolysis are immediately neutralized and converted into fatty acid salts, as shown in the equation below . the result is soap and glycerol (fatty acid salt) .

The process is called Saponification.



Test for fatty acids and triglycerides

1-Solubility Test



This is a general test to show that oil is insoluble in water and soluble in organic solvents .

Principle

This test is based on the principle of solubility of oil in organic solvents and insolubility in water

Procedure :

Take 2 test tubes in one of them put 3 cc of water and in the other put 3cc of ether , chloroform or benzene . in both test tubes add 5 drops of oil , mix and allow them to stand . Oil and water separate quickly and where as a clear solution is formed in the other test tube . this shows that oil is in soluble in water and soluble in organic solvents.

2-Iodine Test

Principle

Unsaturated fatty acid can add halogens (iodine) at the double bonds to form halogenated derivatives , while saturated fatty acids cannot . Oil contain a higher percent of unsaturated fatty acids than solid fat, so oils can react with more iodine .

Procedure :

Dissolve 3 drops of the oily materials or a little piece of the solid fat in 3 ml chloroform , drop by drop add I_2 solution



, count the number of drops needed to produce a permanent color , in the case of saturated fatty acids , solid fats , liquid oils and unsaturated fatty acids.

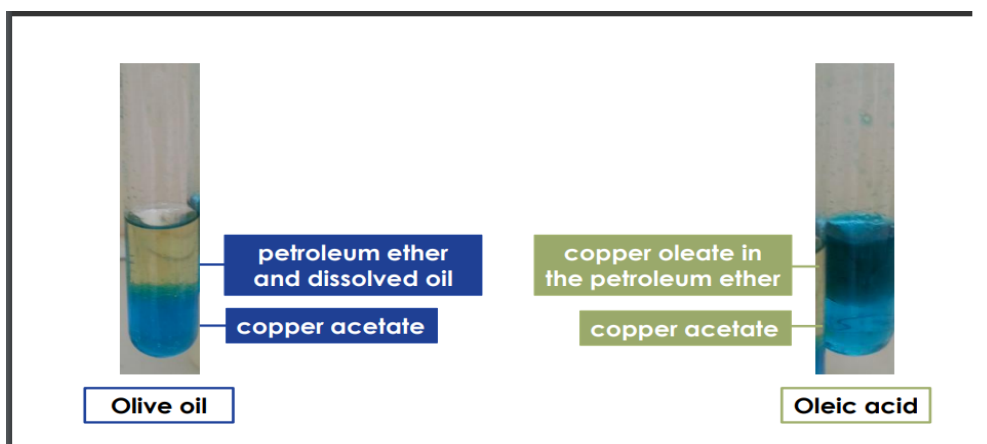
3-Copper acetate Test

Principle

This test used to distinguish between oil or neutral fat and fatty acid saturated and unsaturated, The copper acetate solution does not react with the oils, while saturated and unsaturated fatty acids react with copper acetate to form copper salt. unsaturated fatty acids can only be extracted by petroleum ether.

In the case of olive oil notice that petroleum ether upper layer containing the dissolved oil and appears colorless, aqueous solution remains blue in the bottom. In the case of oleic acid the upper layer of petroleum ether becomes green as a result of copper oleate. The lower layer becomes less in blue.

In the case of stearic acid notice that the petroleum ether upper layer remains colorless, while consists of pale green precipitate of copper stearate at the bottom.



Procedure :

Olive oil , oleic acid, petroleum ether ,copper acetate solution (5%), Take two test tubes put 0.5 g of each sample and then added 3 ml of petroleum ether and an equal volume of a solution of copper acetate.

Note:

The reaction is used to differentiate between triglycerides saturated fatty acids and unsaturated fatty acid. Avoid shaking the two layers vigorously to avoid the formation of a heavy emulsion , shake the two layers gently , or mix by inversion.

4-Salkowski test

Principle

As a rule , when sterols , with unsaturated configuration in their molecules are treated under anhydrous conditions with



a strong acid , they display characteristic colors . the mechanism of the reaction involves production on activated acid complex , followed by the aggregation of several molecules which may yield a conjugated system . the chromogenic substance produced behave like acid – base indicators.

Reagent

1-0.5 % cholesterol solution in chloroform

2-Conc. H_2SO_4

Procedure

Place in dry test tube 2ml of 0.5% cholesterol solution in chloroform; add an equal volume of conc. H_2SO_4 . Mix carefully and allow to stand , the upper chloroform layer becomes red and the lower layer with a green fluorescence .

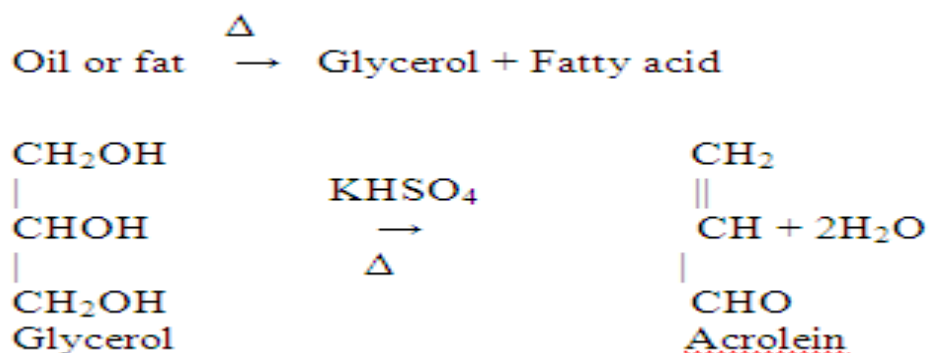
Test for glycerol

1-Acrolein Test

This test is used for identify glycerol which had been formed from hydrolyzed triglycerides to glycerol and F.F.A.

Procedure

Add few amount of solid $KHSO_4$ in a dry test tube , then add few drops (5 drops) of glycerol , then heat gradually , notice the resurrecting a smell of a dust fat ... that make indication for glycerol .



2- Dunstan's test

Add 1 ml from glycerol in a dry test tube , then add 7 drops of (5% $\text{K}_2\text{Cr}_2\text{O}_7$ solution or 5% potassium chromate solution) , then add 1.5 ml from conc. HNO_3 , observe the formation of a blue color , that makes indication for glycerol.