Lipid: classification and Importance

Topics :

Lipids: classification and Function

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What are Lipids?

Lipids are macromolecules made of fatty acid monomers.

"Lipids are organic compounds that contain hydrogen, carbon, and oxygen atoms, which form the framework for the structure and function of living cells."

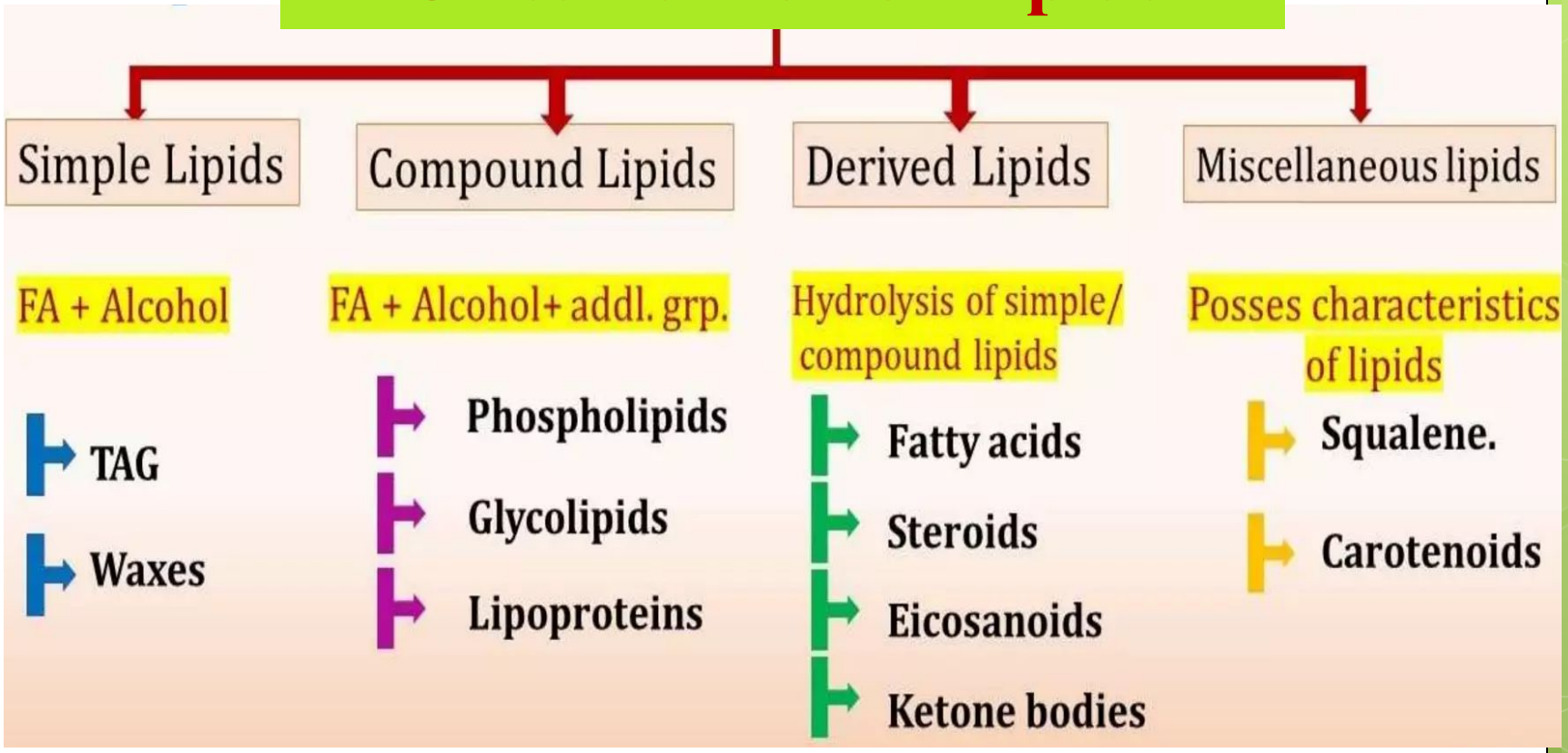
Definition of Lipids

- Organic substances
- relatively insoluble in water,
- soluble in non-polar organic solvents (alcohol , ether, benzene, chloroform, etc.)
- actually or potentially related to fatty acids and
- utilized by the living cells

General Properties of Lipids

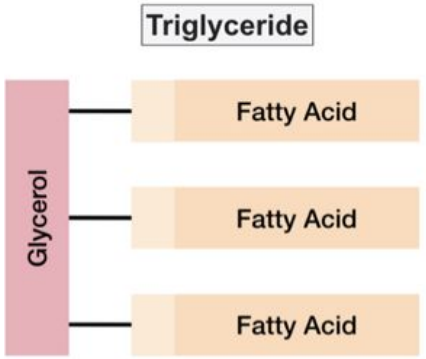
1. Insoluble in water.
2. Soluble in non-polar organic solvents **e.g.** ether, acetone,..
3. Contain carbon, hydrogen, and oxygen; sometimes contain nitrogen and phosphorus.
4. On hydrolysis they give fatty acids.
5. Take part in plant and animal metabolism.

Classification of Lipids

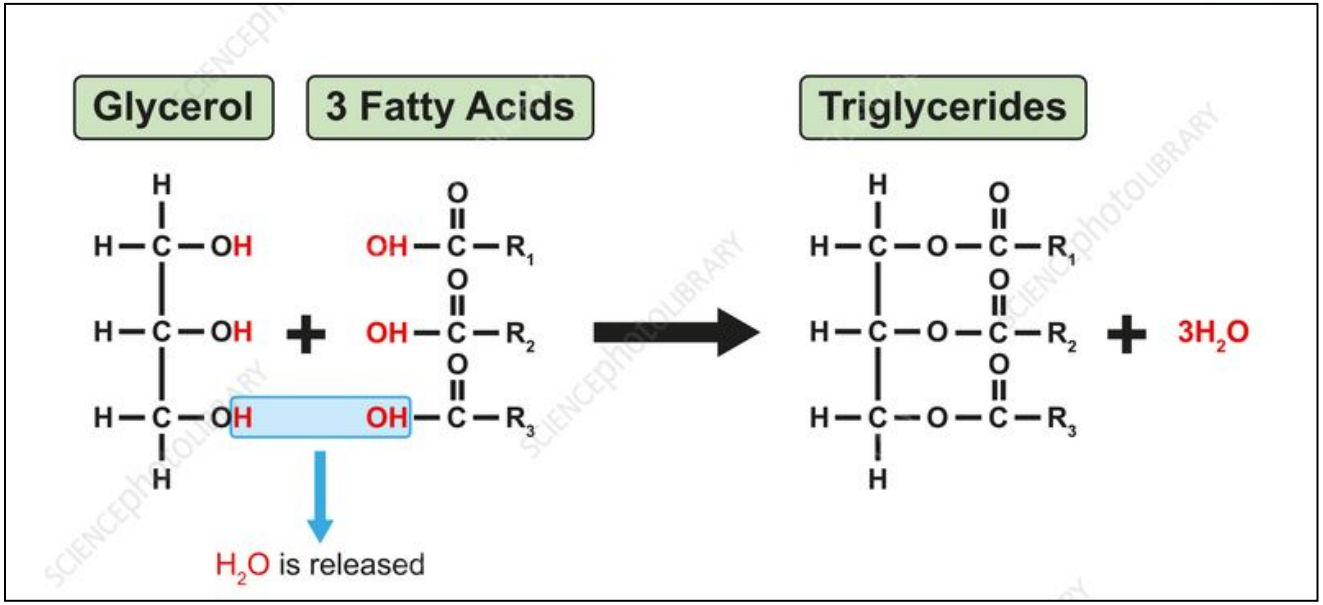


What are Triglycerides?

Triglycerides are a type of fat. They are the most common type of fat in your body. They come from foods, especially *butter*, *oils*, and other fats you eat. Triglycerides also come from extra calories.



- **Triglycerides are ester of glycerol and Fatty acids**

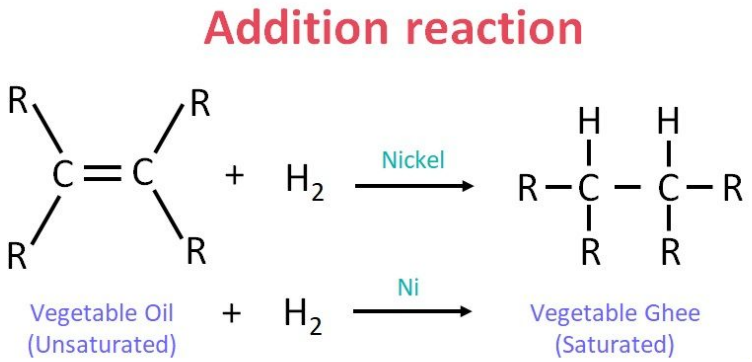


The chemical linkage between the glycerol and fatty acids is called the ester bonds

Some Term related to Lipid

Hydrogenation of Oils

Hydrogenation is the process of adding hydrogen to an unsaturated hydrocarbon to obtain a saturated hydrocarbon.



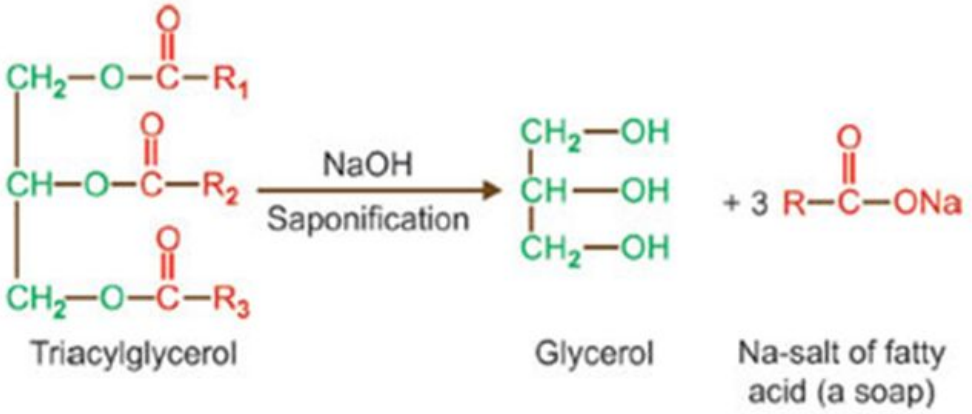
Rancidity:

Condition produced by aerial oxidation of unsaturated fat present in foods and other products, marked by unpleasant odour or flavour

- **Due to the oxidation of unsaturated fatty acids or hydrolysis of fats and oils, it produces an undesirable odor. In food industries, rancidity is one of the major concerns.**

Saponification

- Saponification is a process that involves the conversion of fat, oil, or lipid, into soap and alcohol by the action of heat in the presence of aqueous alkali (e.g. NaOH).
- Soaps are salts of fatty acids.



I. SIMPLE LIPIDS:-

- Esters of fatty acids with glycerol.
- Mainly of two types:-

i. **Fats and oils**:

-These are esters of fatty acids and glycerol.

-difference b/w fats and oils is physical.

ii. **Waxes :**

-Esters of fatty acids+alcohol other than glycerol.

-Cetyl alcohol is most commonly used

DIFFERENCE BETWEEN FATS AND OILS

FATS	OILS
•They're solid at room temperature	•They're liquid at room temperature
.•Obtained from animal body, stored under skin or around organs.	•Obtained from plants.
• Mainly composed of saturated fatty acids.	•Mainly composed of unsaturated fatty acids.
•Increase cholesterol levels in blood and hence increase risk of cardiovascular disease	•Lower cholesterol levels in blood and hence decrease risk of cardiovascular disease.
Eg: ghee, cream, meat, etc	Eg: coconut oil, olive oil, etc

Waxes

- Are esters of fatty acids and a long-chain, high-molecular weight alcohol.
- Waxes is found in both animals and plants .

animals	plants
produced by insects	covering the external parts, like the epidermis of leaves and fruits, where their main function is to prevent the loss of water. (Cuticle)
Beeswax - produced by honey bees	1-Soy wax - from soybean oil. 2-Bayberry wax - from the surface wax of the fruits of the bayberry shrub. 3-Castor wax - catalytically hydrogenated castor oil.

COMPLEX OR COMPOUND LIPIDS:-

- Esters of fatty acids+Alcohol+other groups like phosphate,Nitrogenous base,carbohydrate ,Protein,etc.
- Based on the group present they are further classified into:-
  i. **PHOSPHOLIPIDS**:-
     - F.A+Alcohol+phosphoric acid as nitrogenous base.
     - Based on the type of alcohol present they are again divided into
       - **Glycerphospholipids**:Contain Glycerol as alcohol. Eg:lecithin &cephalin
       - **Sphingophospholipids** : Contain sphingosine as alcohol. Eg: sphingomyelin

ii.GLYCOLIPIDS:-

- Fatty acids+alcohol+carbohydrate as nitrogenous base.
- They contain sphingosine as alcohol and hence also known as **GLYCOSPHINGOLIPIDS.**
- **Eg:** Cerebrosides and Gangliosides.

iii.LIPOPROTEINS:-

- Macromolecular complexes of lipids with proteins.
- Eg:LDL,VLDL,Chylomicrons,HDL,etc

DERIVED LIPIDS:-

- These are the derivatives of hydrolysis of simple and complex lipids which possess the characteristics of lipids.
- These include:
  - Lipid soluble vitamins
  - Steroid hormones
  - Hydrocarbons
  - Ketone bodies
  - Mono and diacylglycerol ,etc

- **Fat-soluble vitamins:** **Vitamins A, D, E, and K**
- **Steroid hormones** **:Testosterone, Estrogen,Progesterone**
- **Ketone bodies :** **acetone, acetoacetate and 3-beta-hydroxybutyrate**

NEUTRAL LIPIDS:-

- These are the lipids which are uncharged and are reffered ro as neutral lipids.
- These are mono,di and triacylglycerols, cholestrol and cholesteryl esters.

Cholesterol :

- One of the Sterols
- Its found different concentration in animal tissues & Blood
- It is synthesize in body by the Liver
- Body normally synthesized 2 gm/Day
- Normal level in Blood = 150- 250 mg/dl
- Cholesterol is precursor of the bile salt
- It is restricted in Atherosclerosis.

MISCELLANEOUS LIPIDS:

- The posses characteristics of Lipids
- These include compounds, which contain characteristics of lipids.
- They include squalene, terpenes, carotenoids, etc.

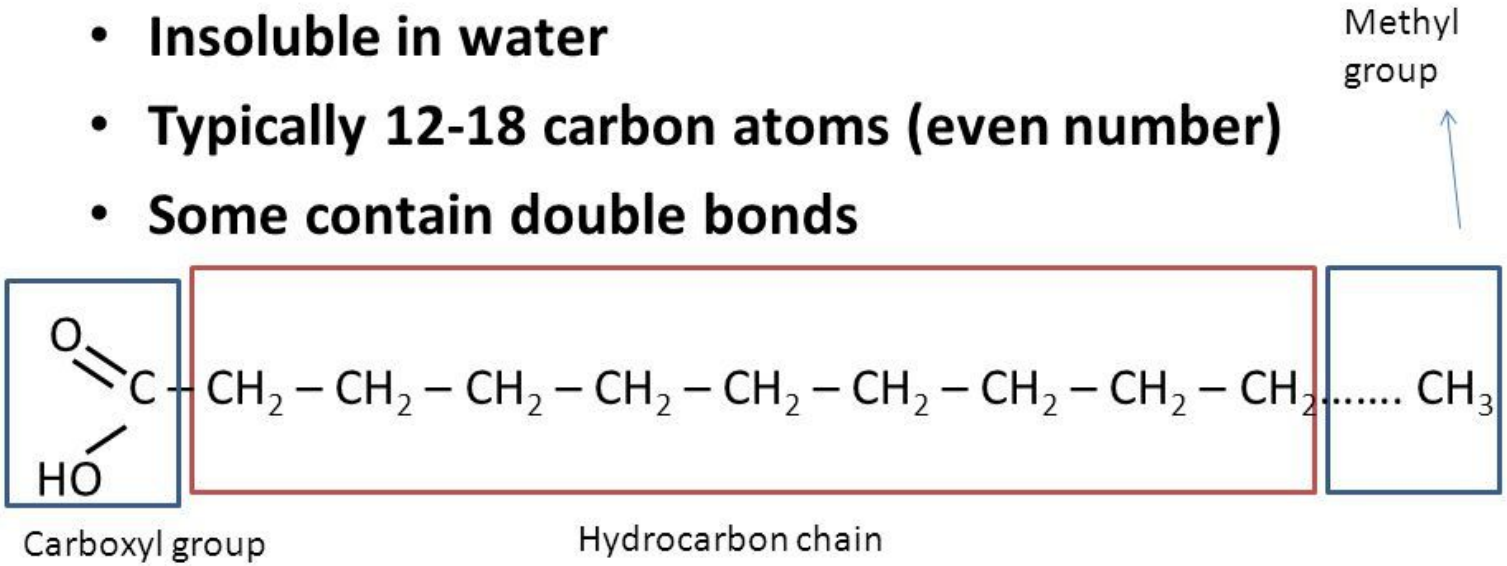
Squalene is a polyunsaturated hydrocarbon found in certain fish oils, especially shark liver oil.

Terpene constituting 90% of the essential oils, They are mostly found in plants and form the major constituent of essential oils from plants

Carotenoids are natural lipophilic pigments, are present in photosynthetic bacteria, some species of archaea and fungi, algae, plants, and animals

Fatty Acids

- Fatty acids are aliphatic straight chain hydrocarbon compounds with a terminal carboxylic group.
- They are building blocks of lipids
- Insoluble in water
- Typically 12-18 carbon atoms (even number)
- Some contain double bonds



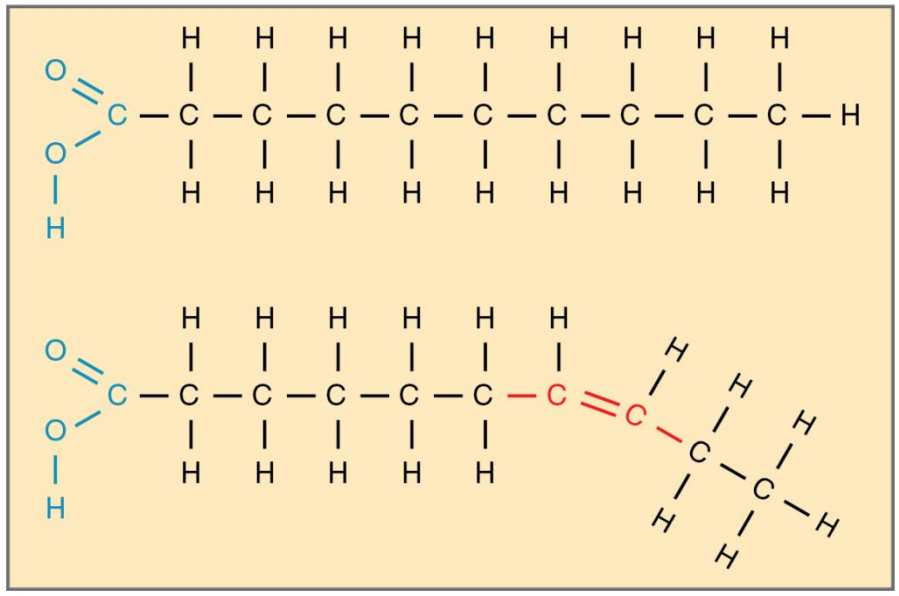
Fatty acids are said to be *amphipathic by nature* as they have both polar and nonpolar ends.

Types of fatty acid

No.	Saturated fats	Unsaturated fats
(a)	They contain single chain of carbon atoms with single bonds.	They contain chain of carbon atoms with one or more double bonds.
(b)	They are solid at room temperature.	They arc liquid at room temperature.
(c).	They increase blood cholesterol level by depositing it in the inner wall of arteries.	They lower the blood cholesterol level and have many health benefits.
(d)	They do not get spoiled.	They get spoiled easily.
(e)	Saturated fats are obtained from animal fats, palm oil, etc.	Unsaturated fatty acids are obtained from plant and vegetable oil, etc.

(a) Saturated

(b) Unsaturated



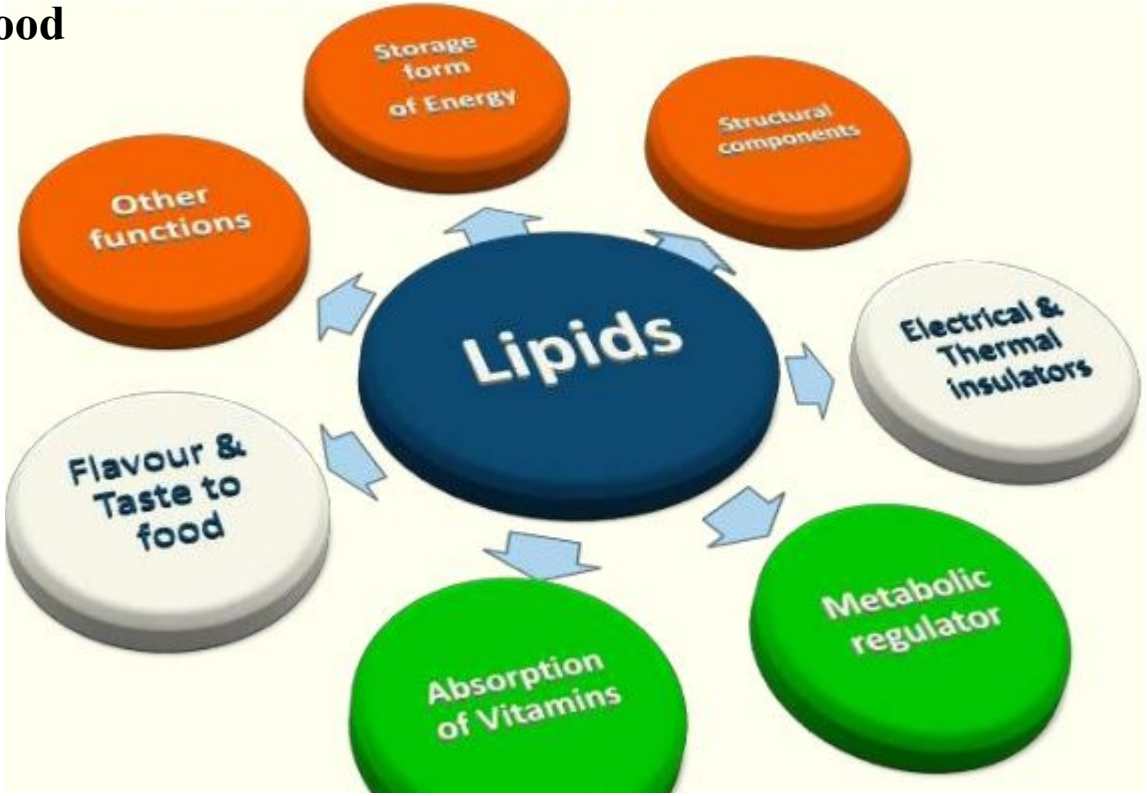
Used of Fats in the body

- **Used by the body as a fuel**, producing more energy/g than either carbohydrate or protein produce.,
  - **4 kcal/g** are produced from protein or carbohydrate
  - **9 Kcal/g** are produced by fats.

- **Fat is more efficient** in storing energy in the body than carbohydrate.

FUNCTIONS OF LIPIDS

1. **Storage form of Energy**
2. **Structural Components**
3. **Electrical & Thermal Insulators**
4. **Metabolic regulation**
5. **Absorption of Vitamin**
6. **Flavor & Taste to food**
7. **Other function**



Importance's of Lipids

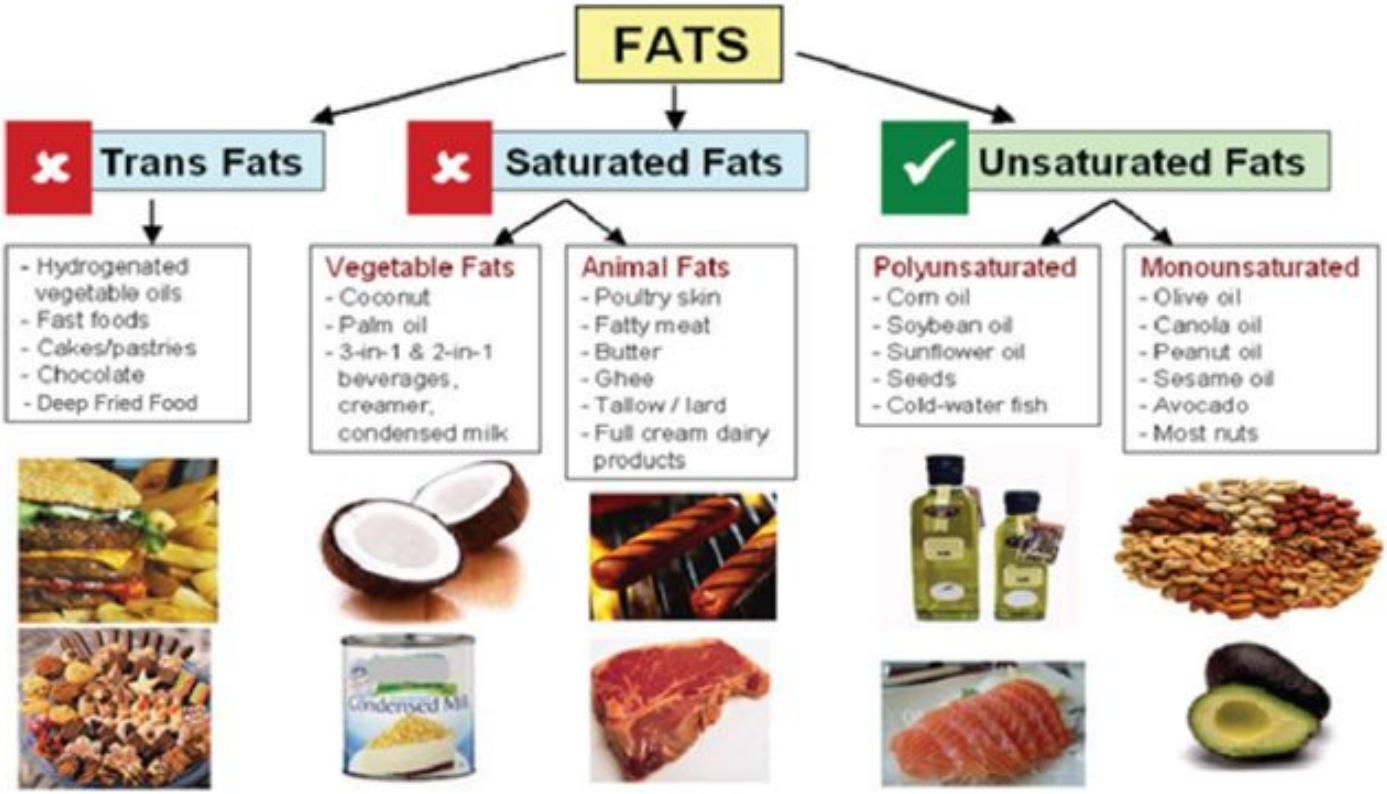
1. Storage form of energy (triglycerides)
2. Structural components of biomembranes
3. Metabolic regulators (steroid hormones), prostaglandins, leukotrienes.
4. Act as surfactants, detergents and emulsifying agents (amphipathic lipids)
5. Act as electric insulators in neurons
6. Provide insulation against changes in external temperature (subcutaneous fat)
7. Give shape and contour to the body
8. Protect internal organs (pads of fat)
9. Help in absorption of fat soluble vitamins (A, D, E and K)

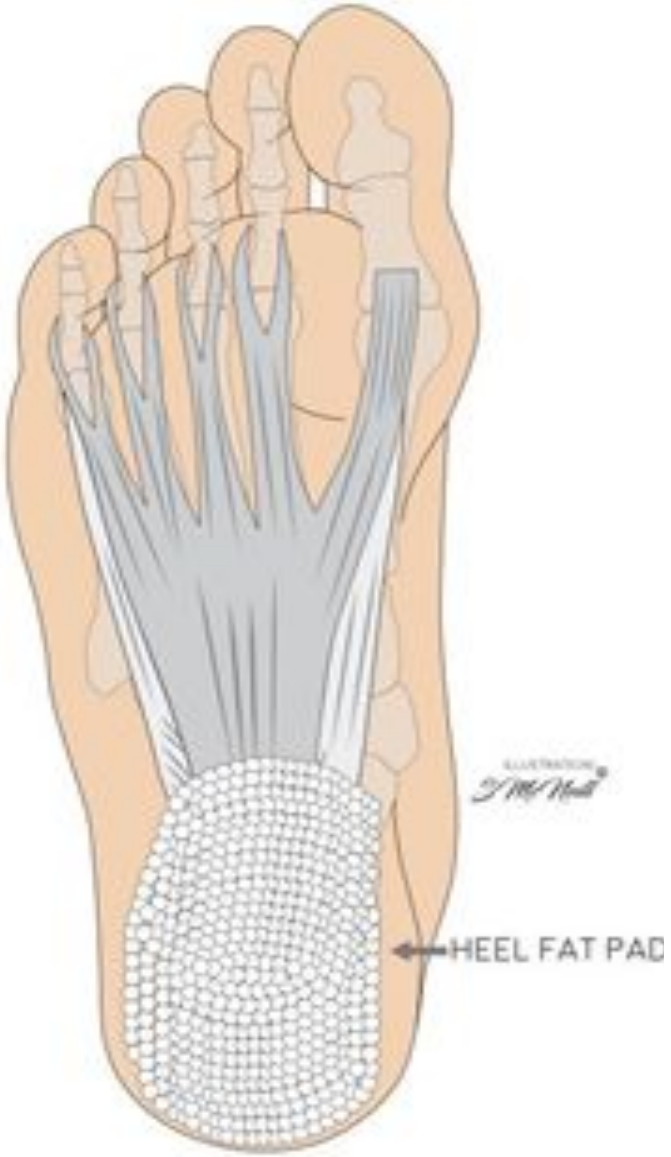
CLASSIFICATION OF FATTY ACIDS…

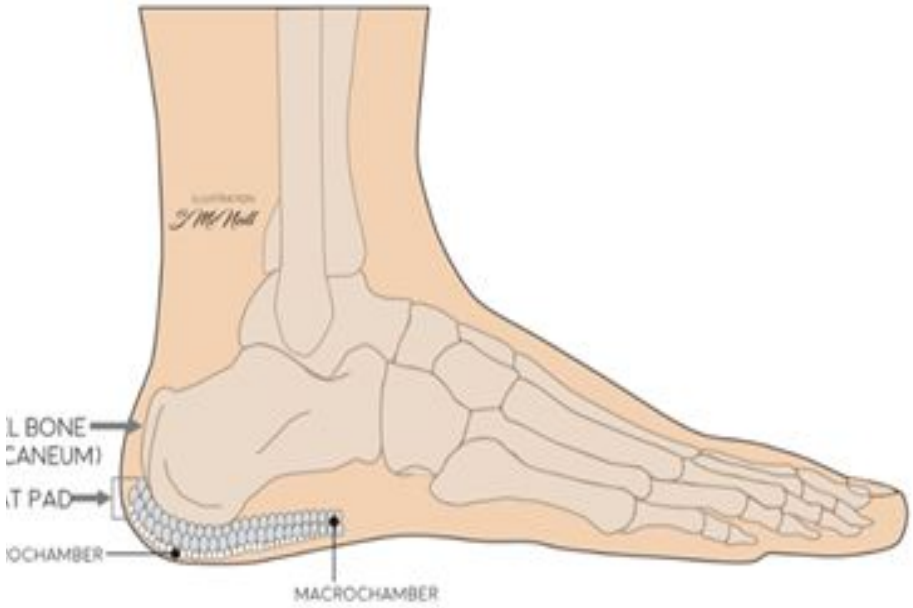
- **According To The Body Requirement**
  - **Essential fatty acids**

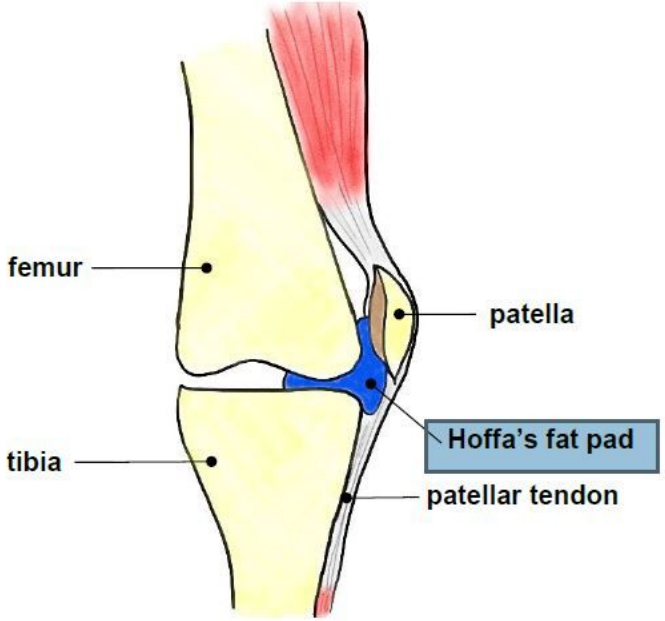
    Essential fatty acids are the fatty acids that **cannot be prepared by the body** and are obtained from **diet.** Our body is not capable to synthesize them. For example, linoleic acid, linolenic acid, arachidonic acid.
  - **Non-Essential fatty acids**

    Fatty acids that can be **synthesized by our body** and are not required from diet. For example, Palmitic acid, Stearic acid.


FATS
Trans Fats
- Hydrogenated vegetable oils
- Fast foods
- Cakes/pastries
- Chocolate
- Deep Fried Food
Saturated Fats
Vegetable Fats
- Coconut
- Palm oil
- 3-in-1 & 2-in-1 beverages, creamer, condensed milk
Animal Fats
- Poultry skin
- Fatty meat
- Butter
- Ghee
- Tallow / lard
- Full cream dairy products
Unsaturated Fats
Polyunsaturated
- Corn oil
- Soybean oil
- Sunflower oil
- Seeds
- Cold-water fish
Monounsaturated
- Olive oil
- Canola oil
- Peanut oil
- Sesame oil
- Avocado
- Most nuts
Condensed Milk

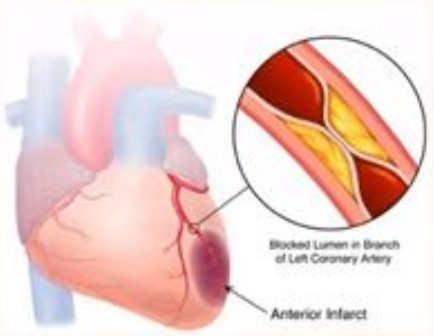

HEEL FAT PAD


L BONE
CANEUM)
T PAD
OCHAMBER
MACROCHAMBER


femur
patella
Hoffa's fat pad
tibia
patellar tendon

Clinical Importance of Lipids

Atherosclerosis



Diabetes Mellitus

Obesity

Fatty Liver


thank
you