



# Organic Chemistry IV

**Presented by:**

Dr. Neeraj Sharma

Assistant Professor

# Lipids

- *“Lipids are organic compounds that contain hydrogen, carbon, and oxygen atoms, which forms the framework for the structure and function of living cells.”*
- These organic compounds are nonpolar molecules, which are soluble only in nonpolar solvents and insoluble in water because water is a polar molecule.
- In the human body, these molecules can be synthesized in the liver and are found in oil, butter, whole milk, cheese, fried foods, and also in some red meats.

# Lipids

- Lipid, any of a diverse group of organic compounds including fats, oils, hormones and certain components of membranes that are grouped together because they do not interact appreciably with water.
- One type of lipid, the triglycerides, is sequestered as fat in adipose cells, which serve as the energy-storage depot for organisms and also provide thermal insulation.
- Some lipids such as steroid hormones serve as chemical messengers between cells, tissues, and organs, and others communicate signals between biochemical systems within a single cell.

# Lipids

- The membranes of cells and organelles (structures within cells) are microscopically thin structures formed from two layers of phospholipids molecules.
- Membranes function to separate individual cells from their environments and to compartmentalize the cell interior into structures that carry out special functions.
- So important is this compartmentalizing function that membranes, and the lipids that form them, must have been essential to the origin of life itself.

# Lipids

- Lipids are molecules that contain hydrocarbons and make up the building blocks of the structure and function of living cells.
- Examples of lipids include fats, oils, waxes, certain vitamins (such as A, D, E and K), hormones and most of the cell membrane that is not made up of protein.
- Lipids are not soluble in water as they are non-polar, but are thus soluble in non-polar solvents such as chloroform.

# Lipids

- **What do Lipids Consist of?**
- Lipids are mainly composed of hydrocarbons in their most reduced form, making them an excellent form of energy storage, as when metabolized the hydrocarbons oxidize to release large amounts of energy.
- The type of lipid found in fat cells for this purpose is a triglyceride, an ester created from glycerol and three fatty acids.

# Lipids

- **Where do Lipids Come From?**
- Excess carbohydrates in the diet are converted into triglycerides, which involves the synthesis of fatty acids from acetyl-CoA in a process known as lipogenesis, and takes place in the endoplasmic reticulum.
- In animals and fungi, a single multi-functional protein handles most of these processes, while bacteria utilize multiple separate enzymes.
- Some types of unsaturated fatty acids cannot be synthesized in mammalian cells, and so must be consumed as part of the diet, such as omega-3.

# Properties of Lipids

- Lipids are a family of organic compounds, composed of fats and oils. These molecules yield high energy and are responsible for different functions within the human body. Listed below are some important characteristics of Lipids.
- Lipids are oily or greasy nonpolar molecules, stored in the adipose tissue of the body.
- Lipids are a heterogeneous group of compounds, mainly composed of hydrocarbon chains.



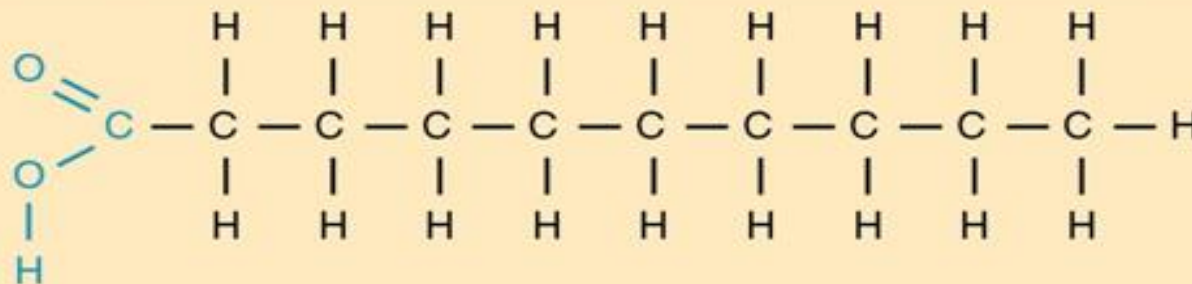
# Properties of Lipids

- Lipids are energy-rich organic molecules, which provide energy for different life processes.
- Lipids are a class of compounds characterised by their solubility in nonpolar solvents and insolubility in water.
- Lipids are significant in biological systems as they form for a mechanical barrier dividing a cell from the external environment known as the cell membrane.

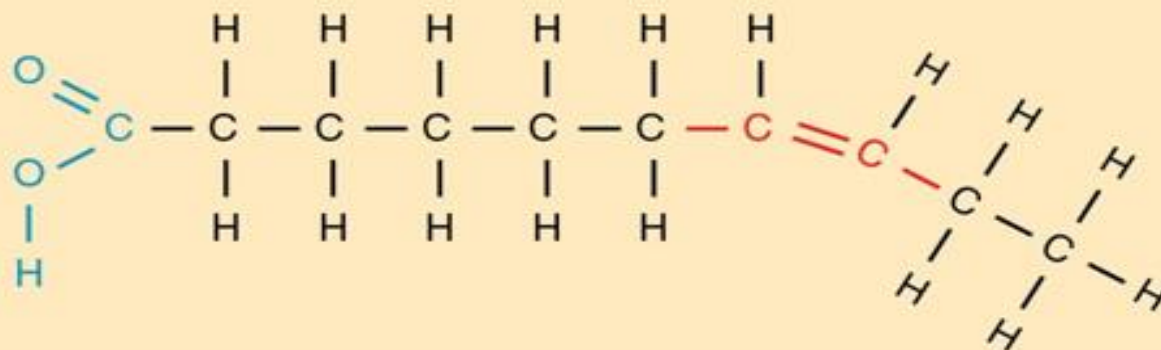
# Structure of Lipids

- Lipids are the polymers of fatty acids that contain a long, non-polar hydrocarbon chain with a small polar region containing oxygen.

(a) Saturated



(b) Unsaturated



# Classification of Lipids

- Lipids can be classified into two main classes:
- **Nonsaponifiable Lipids:**
- A nonsaponifiable lipid cannot be disintegrated into smaller molecules through hydrolysis.
- Nonsaponifiable lipids include cholesterol, prostaglandins etc

# Classification of Lipids

- **Saponifiable Lipids:**
- A saponifiable lipid comprises one or more ester groups, enabling it to undergo hydrolysis in the presence of a base, acid, or enzymes, including waxes, triglycerides, sphingolipids, and phospholipids.
- Further, these categories can be divided into non-polar and polar lipids.

## Classification of Lipids

- Nonpolar lipids, namely triglycerides, are utilized as fuel and to store energy.
- Polar lipids, that could form a barrier with an external water environment, are utilized in membranes. Polar lipids comprise sphingolipids and glycerophospholipids.
- Fatty acids are pivotal components of all these lipids.