

Lipids

- Lipids (fats) are organic compounds that are insoluble in water but soluble in organic solvents such as ether and alcohol.
- They are composed of the same elements as carbohydrates (carbon, hydrogen, and oxygen) but have a higher hydrogen concentration
- Fats may be liquid (oil) or solid

fatty acids

- **Fatty acids** are the basic structural units of most lipids.

Fatty acids are described as saturated or unsaturated.

1. **Saturated fatty acids** are those in which all carbon atoms are filled to capacity (i.e., saturated)

with hydrogen; an example is butyric acid, found in butter.

2. An **unsaturated fatty acid** is one that could accommodate more hydrogen atoms than it currently does. It has at least two carbon atoms that are not attached to a hydrogen atom; instead, there is a double bond between the two carbon atoms.

Fatty acids with one double bond are called **monounsaturated fatty acids**; those with more than one double bond (or many carbons not bonded to a hydrogen atom) are **polyunsaturated**

- An example of a polyunsaturated fatty acid is linoleic acid, found in vegetable oil.
- Lipids are classified as simple or compound.

Glycerides

- the simple lipids, are the most common form of lipids.

They consist of a glycerol molecule with up to three fatty acids attached.

- **Triglycerides** (which have three fatty acids) account for more than 90 % of the lipids in food and in the body.
- Triglycerides may contain saturated or unsaturated fatty acids.
- Saturated triglycerides are found in animal products, such as butter, and are usually solid at room temperature.

Unsaturated triglycerides are usually liquid at room temperature and are found in plant products, such as olive oil and corn

Cholesterol

- is a fat-like substance that is both produced by the body and found in foods of animal origin.

Most of the body's cholesterol is synthesized in the liver; however, some is absorbed from the diet (e.g., from milk, egg yolk, and organ meats).

- Cholesterol is needed to create bile acids and to synthesize steroid hormones.

Cholesterol: It is of two types The good and the bad

- The main two types of lipoproteins carry cholesterol to and from cells are low-density lipoprotein, or LDL, and high-density lipoprotein, or HDL.
- A test measures the amount of each type of cholesterol in your blood.
 - LDL (bad) cholesterol
- LDL cholesterol is considered the “bad” cholesterol, because it contributes to fatty buildups in arteries ([atherosclerosis](#)). This narrows the arteries and increases the risk for [heart attack](#), [stroke](#) and [peripheral artery disease](#) (PAD).

HDL (good) cholesterol

- HDL cholesterol can be thought of as the “good” cholesterol because a healthy level may protect against heart attack and stroke.
- HDL carries cholesterol away from the arteries and back to the liver, where it is broken down and passed from the body. But HDL cholesterol doesn't completely eliminate LDL cholesterol.
- Only one-third to one-fourth of blood cholesterol is carried by HDL.
 - Along with phospholipids, large quantities of cholesterol are present in cell membranes as well as other cell structures.

{Fatty acids, Triglycerides (glycerol + Fatty acids), Cholesterols, and Phospholipids}

Lipid Digestion

- Although chemical digestion of lipids begins in the stomach, they are digested mainly in the small intestine, primarily by bile, pancreatic lipase, and enteric lipase, an intestinal enzyme.
- The end products of lipid digestion are glycerol, fatty acids, and cholesterol.
- **These are immediately reassembled inside the intestinal cells into triglycerides and cholesterol esters (cholesterol with a fatty acid attached to it), which are not water soluble.**
- For these reassembled products to be transported and used, the small intestine and the liver must convert them into soluble compounds called lipoproteins.
- **Lipoproteins** are made up of various lipids and a protein.

Lipid Metabolism

- Converting fat into usable energy occurs through the use of the enzyme hormone-sensitive lipase that breaks down triglycerides in adipose cells, releasing glycerol and fatty acids into the blood.
- 0.45 kg(450 g) of fat provides about 3,500 kilocalories.
- Fasting persons will obtain most of their calories from fat metabolism, but some amount of carbohydrate or protein must also be used because the brain, nerves, and red blood cells require glucose.
- Only the glycerol molecules in fat can be converted to glucose.

The function of Lipids and essential fatty acids.

1. Provide energy needs.
2. Spares protein, insulates human bodies against extreme temperatures.
3. Protects against shock by providing a cushion for bones and vital organs.
4. help to maintain cell membranes and aids in the absorption of vitamins A, D, E and K.
5. As a food ingredient, fat provides flavor, consistency, stability and satiety.
6. Essential fatty acids The term essential fatty acids (EFA) refers to those polyunsaturated fatty acids (PUFA) that must be provided by foods because these cannot be synthesized in the body yet are necessary for health.

There are two families of EFA, omega-3 (ω -3) and omega-6 (ω -6).

Examples: Linoleic acid, alpha-linolenic acid, γ -Linolenic acid, Arachidonic acid

Unsaturated fats

- It is most effective dietary strategy in preventing heart disease may be replacing saturated fats in the diet with monounsaturated and polyunsaturated fats.
- **Sources of monounsaturated fats:** Olive oil, canola oil, peanut oil and avocados.
- **Sources of polyunsaturated fats:** Vegetable oils (safflower, sesame, soy, corn and sunflower), nuts and seeds.
- **Essential fatty acids.**
 - the body can make all except two linoleic and linolenic acids. These two acids must be supplied by the diet.
 - **Linoleic acid sources:** Sunflower, safflower, corn and soybean oils.
 - **Linolenic acid sources:** Soybean and canola oils, walnuts and salmon.

Saturated fats and its risk.

- Saturated fat is implicated in raising LDL cholesterol
- LDL cholesterol raises risk of heart disease

Sources of saturated fats

- 1. animal sources such as: whole milk, cream, butter, cheese and fatty cuts of beef and pork.**
- 2. Coconut.**
- 3. palm and palm kernel oils and products containing them (pastries, pies, doughnuts and cookies and the like) are also sources of saturated fat.**

Trans fat

- The majority of trans fats are formed when liquid oils are made into solid fats like hard margarine.
- However, it is found naturally in some animal based foods as well.
- Trans fat is made when hydrogen is added to an unsaturated fat such as vegetable oil, in a process called hydrogenation.
- Hydrogenation increases the shelf life of products containing these fats.

Sources of Trans fat

1. Found in deep fried foods.
2. cakes, cookies, margarine, meat and dairy products.
3. Partially hydrogenated oils are the main dietary source of trans fats.

Trans fat risks:

Trans fats, like saturated fats, can increase the LDL blood cholesterol levels and increase the risk of heart disease.

Fats related to some diseases such as diabetes mellitus, heart and vascular disease, cancer (breast, colon and Prostate cancers)