

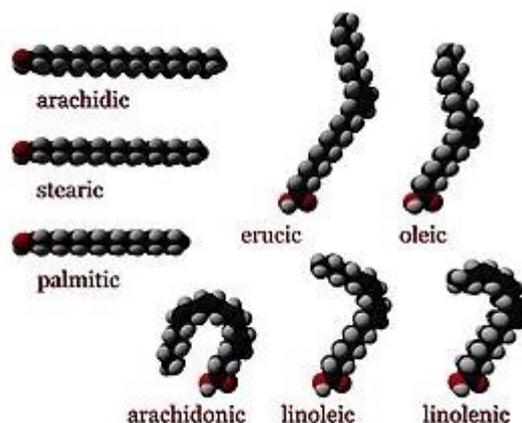
By: Dr. Priyanka Srivastava

Unit 6: Oils and Fats

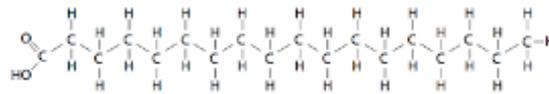
General Description:

Oils and fats are made up of carbon (C), hydrogen (H), and oxygen (O). These elements form chains of molecules called fatty acids. The functionality of fats is due to the fatty acids. Structurally oils and fats are esters of glycerol with three fatty acids i.e. Triacylglycerols or triglycerides. Individual fatty acids can be either **saturated**, **cis-monounsaturated**, **cis-polyunsaturated** and **trans** fatty acids. Saturated fatty acids and *trans* fatty acids are solid at room temperature while the *cis*-unsaturated are liquid at room temperature. However, no natural occurring fat are 100% saturated or 100% unsaturated (but is a mix of the two) and according to the predominance of type they are considered as ‘saturated’ or ‘unsaturated’.

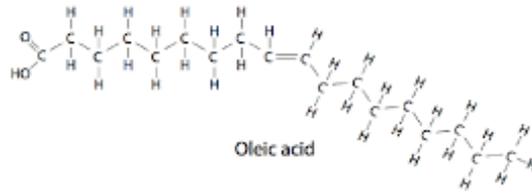
The fatty acids in oils and fats are made up of long chain of carbon and hydrogen. Where carbon atom from 4 to 28 carbon atoms with methyl (CH₃) group at one end and a carboxylic acid (COOH) at the other. It is this carboxylic acid group that reacts with the hydroxyl groups on the glycerol molecule to form the ester linkages of the triacylglycerol molecule.



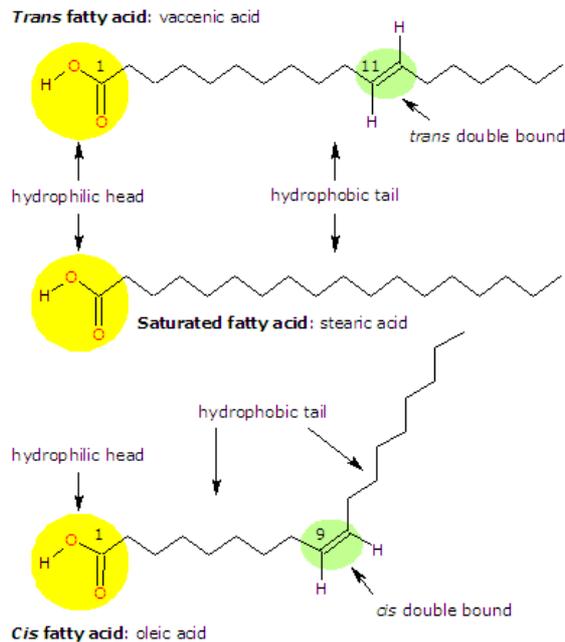
Three-dimensional representations of several fatty acids. Saturated fatty acids have perfectly straight chain structure. Unsaturated ones are typically bent, unless they have a *trans* configuration. (https://en.wikipedia.org/wiki/Fatty_acid)



Stearic acid



Oleic acid



Structure of fatty acid

(<https://www.tuscany-diet.net/2014/06/27/trans-fatty-acids/>)

Fatty acids can be grouped into four main types:

- Saturated
- Monounsaturated
- Polyunsaturated
- Trans

1. **Saturated fatty acids** are straight chains of carbon atoms consisting of methylene (CH₂) groups between the end methyl and carboxylic acid groups. The most common saturated fatty acids are lauric acid (C₁₂), palmitic acid (C₁₆) and stearic acid (C₁₈), butterfat (e.g. C₄, butyric acid) and coconut oil (e.g. C₈, caprylic acid, and C₁₀, capric acid).

2. Monounsaturated fatty acids contain a single carbon-carbon double bond in between carbon atoms 9 and 10 of the carbon chain. This is usually in the cis configuration. Eg. Oleic acid (18 carbon).
3. **Polyunsaturated fatty acids** have more than one double bond in the carbon chain. Eg. linoleic acid (18 carbon atoms and 2 double bonds between carbon atoms 9/10 and 12/13) and linolenic acid (18 carbon atoms and 3 double bonds between carbon atoms 9/10, 12/13 and 15/16).
4. **trans fatty acids**, are also unsaturated where some or all of the double bonds are in the *trans* configuration. Commonly found as a result of either hydrogenation of fats or by keeping fats at a very high temperature (>200°C) for extended periods of time. Eg. used frying oil, vaccenic acid in milk.

Fats:

Fats occur in the animal body, under the skin or around organs hence they are animal-derived. Fats are higher in energy. They are mainly composed of **saturated fatty acids**. Therefore, **they are solid at room temperature**. In animals, fats are stored in specialized cells adipocytes. Some of the fat can be found in the liver as well. Saturated fats are present in dairy food such as cheese, butter, cream, full-fat milk, and meat. While trans-fat naturally occurs in animal meat and dairy products in small amounts. Most of the trans-fat is made up of partial hydrogenation of vegetable oils and increases low-density lipoprotein (LDL) levels in the blood which result in decrease of the high-density lipoprotein (HDL) levels in the blood. This decrease can cause cardiovascular diseases.

Oils:

Oils occur in fruits or seeds of plants and is in the form of viscous liquids. They are composed of mainly **unsaturated fatty acids** hence **exist as liquids at room temperature**. Unsaturated fats lower the risk of heart diseases by lowering the levels of cholesterol in the blood. Eg. Rapeseed oil, sunflower oil, olive oil, soybean oil, corn oil, and palm oil etc. Monounsaturated fats in oil contains single double bond in their molecular structure are stable to oxidation (delays rancidity) eg. Olive oil and rapeseed oil. Polyunsaturated fats possess double bonds in their structure and are less stable to oxidation and are good to use in cold temperatures. Eg. Sunflower oil.

Referred links:

<https://www.ifst.org/resources/information-statements/oils-and-fats>

<http://pediaa.com/difference-between-fats-and-oils/>