

Tishk International University
Faculty of Applied Science
Nutrition and Dietetics Department
2nd Grade
Nutritional Biochemistry



Lipids

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Overview



- Classification
- Function of lipids
- Dietary lipid metabolism
- Digestion, absorption, secretion and utilization of dietary lipids
- Biomedical importance of lipids

Lipid Chemistry

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graph LR; A[Definition] --> B[Classification]; B --> C[Biological Importance]
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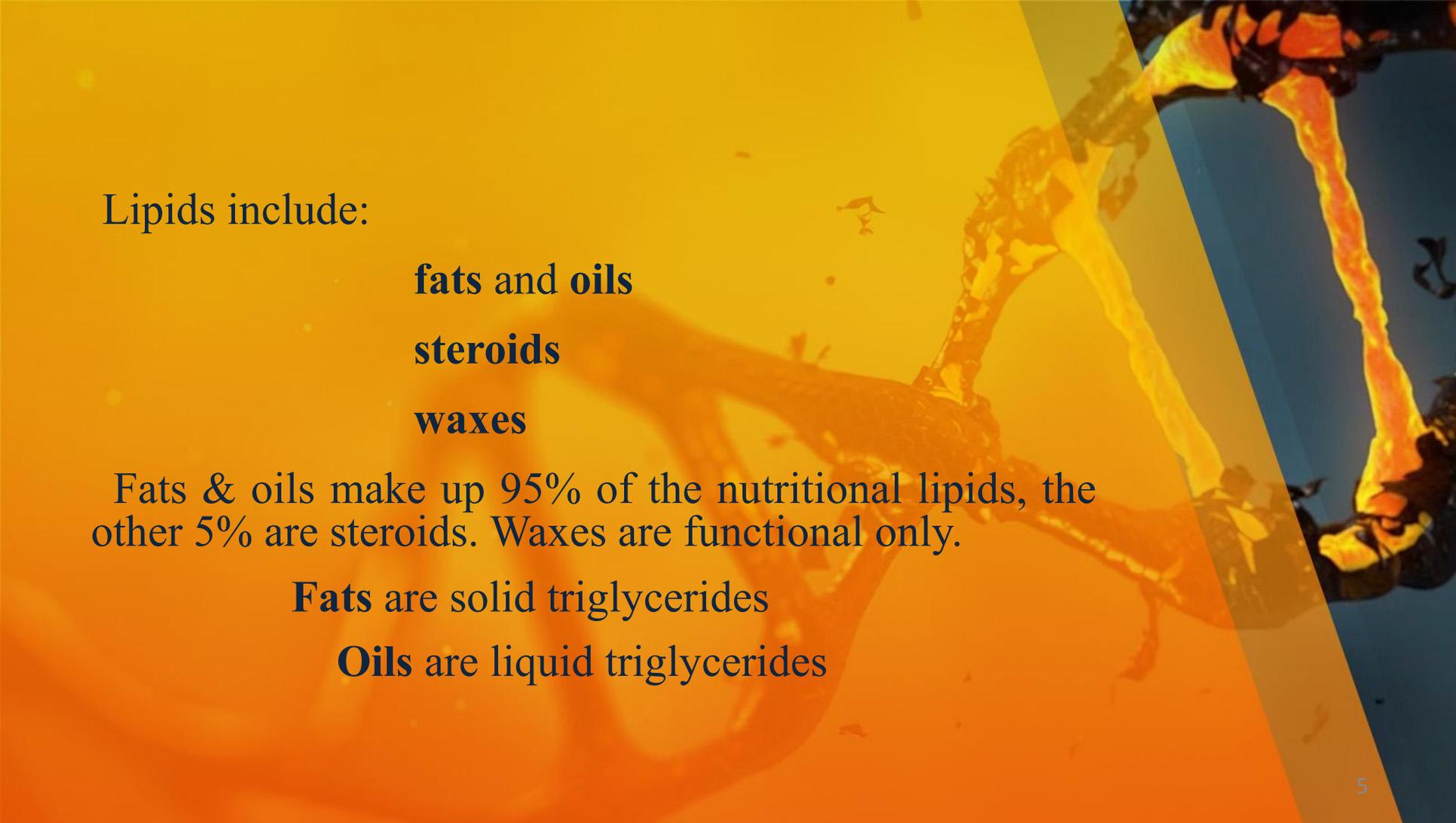
Definition

Classification

Biological
Importance

Lipids

- Are a heterogeneous group of water-insoluble (hydrophobic) organic molecules.
- Lipids are a major source of energy for the body.
- Lipids serve additional functions in the body,
e.g: some-fat soluble vitamins have regulatory or coenzyme functions, and the prostaglandins and steroid hormones play major roles in the control of the body's homeostasis.
- Deficiencies or imbalances of lipid metabolism can lead to some of the major clinical problems, such as atherosclerosis, diabetes and obesity.



Lipids include:

fats and oils

steroids

waxes

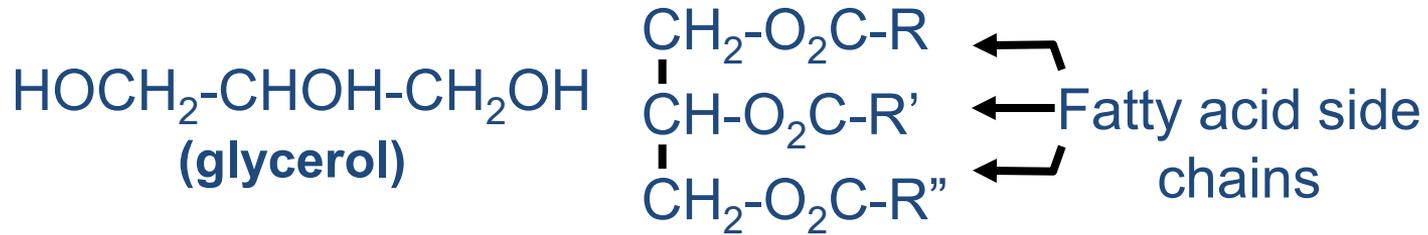
Fats & oils make up 95% of the nutritional lipids, the other 5% are steroids. Waxes are functional only.

Fats are solid triglycerides

Oils are liquid triglycerides

Fats and Oils

The Triglycerides We Eat

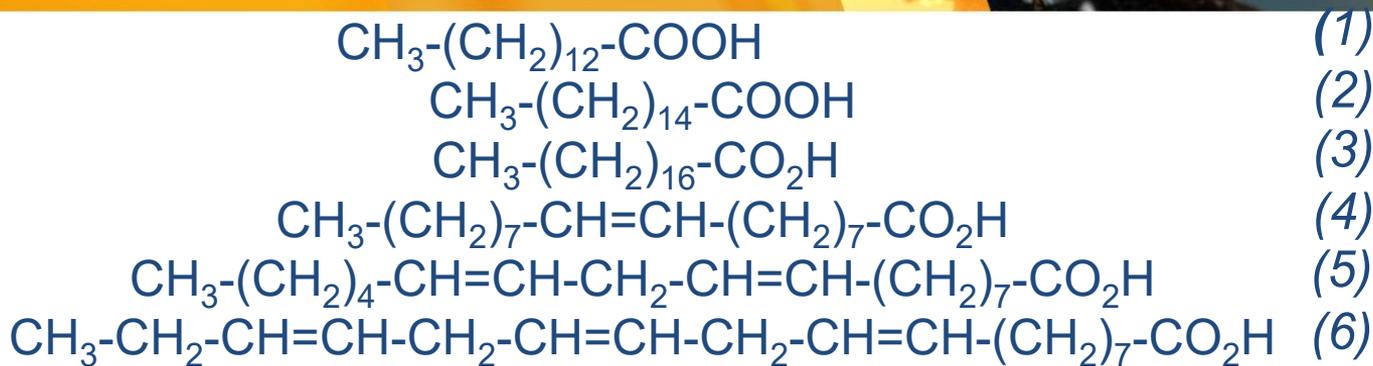


Triglycerides/fatty acids are characterized/named by:

- 1) The length/number of carbons in the side chains
- 2) The number of carbon-carbon double bonds in the side chains (the *degree of unsaturation*).

Representative Fatty Acids

C12-C18(also C20) Dietary Fats and Oils



Name	Mp(°C)	Class
(1) Myristic acid	58	Saturated C-14
(2) Palmitic acid	63	Saturated C-16
(3) Stearic acid	71	Saturated C-18
(4) Oleic acid	4	Monounsaturated C-18
(5) Linoleic acid	- 5	Polyunsaturated C-18
(6) Linolenic acid	- 11	Polyunsaturated C-18



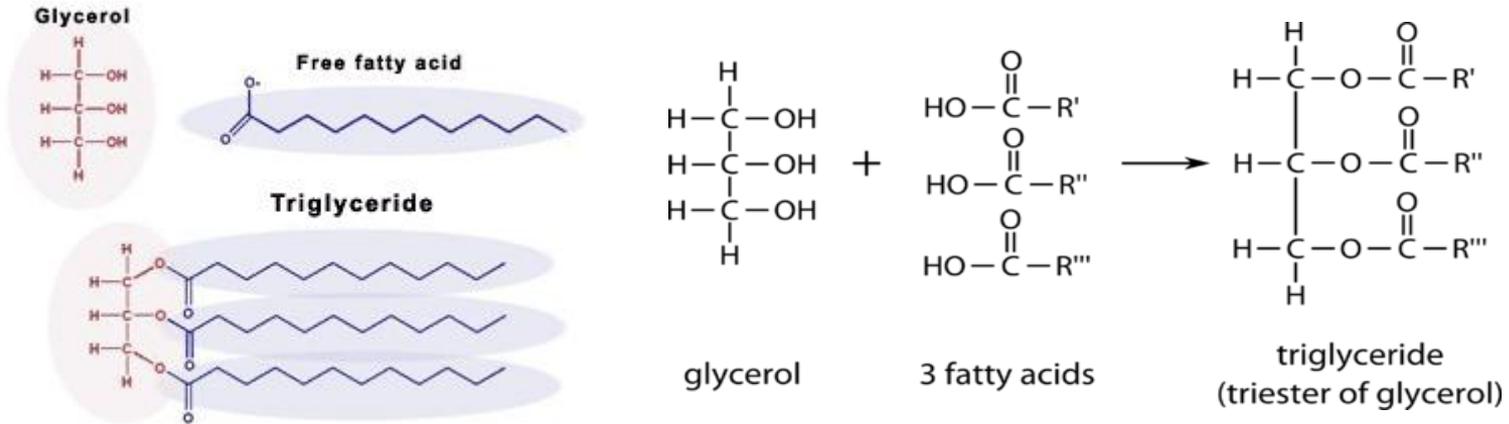
FATTY ACIDS (TRIGLYCERIDES)

Solid: longer chains
saturated (only C-C)
e.g. animal fat, butter

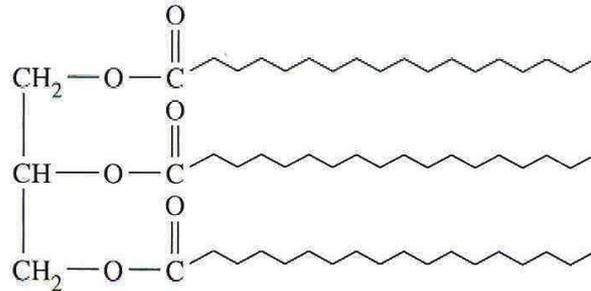
Liquid: unsaturations (C=C)
e.g. many vegetable oils
(olive, sunflower)

TRIACYLGLYCEROLS

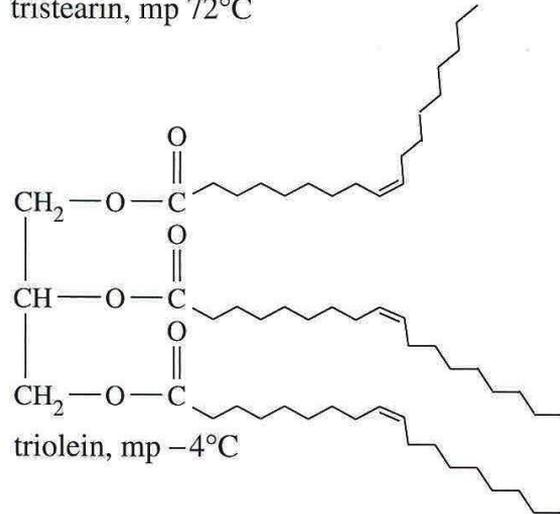
- Also known as triglycerides.
- Main storage of fatty acids.
- Esters of trihydric alcohol (glycerol) and fatty acids.



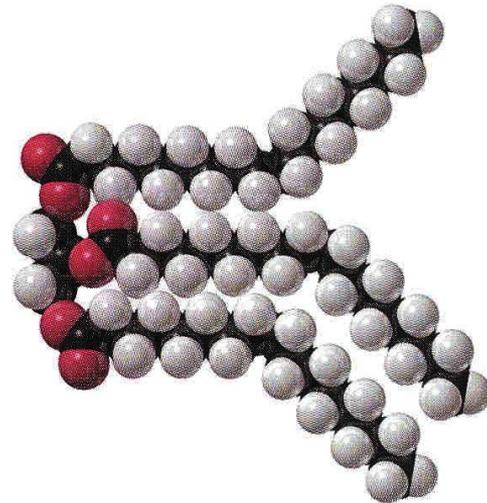
Unsaturates can't fit well into a solid lattice



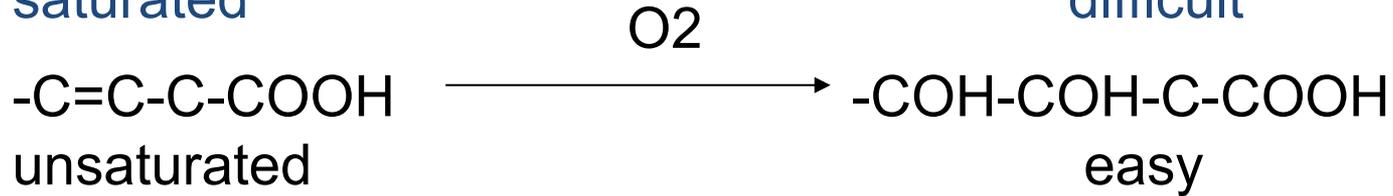
tristearin, mp 72°C



triolein, mp -4°C



Oxidation of Organic Compounds, e.g. fatty acids

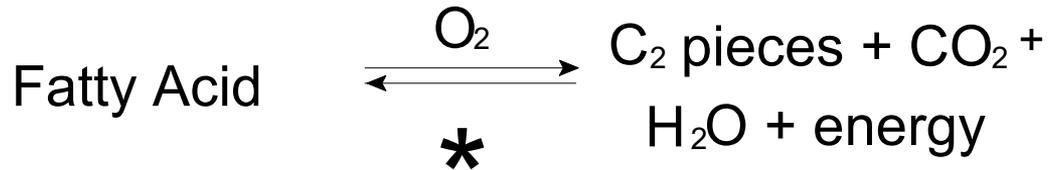


oxidation = decomposition = rancidity

more saturated = more stable, i.e. longer 'shelf life',
e.g. commercial baked goods

more unsaturated = faster deterioration, i.e. need
antioxidants to protect compounds (in the body?)

Reactions (Metabolic)



Humans cannot make:

- * “Essential” Fatty Acids: Linoleic: 18(9,12)
Linolenic: 18(9,12,15)



Body fat is stored energy

The body converts the unused carbohydrates, proteins and triglycerides that make up our macronutrients into small globules of fat that end up in the specialized cells of **adipose tissue**, the fatty tissue of the body.

One pound of adipose tissue stores, and provides when needed, **~3500 Cal** of energy.

Fat = Essential Energy

Most of our **long-term energy** supplies operates via the formation, storage and metabolism of **body fat (triglycerides)**.

Short term energy storage, from one meal to another, occurs through a starch-like substance called **glycogen** (a carbohydrate).

Adipose Tissue / Fat

Adipose tissue forms cushioning shields around our major organs, protecting them against damage from physical shock and provides insulation to our bodies, guarding against a rapid loss of body heat to the external environment .

Fats carry the flavors and vitamins of many of our foods although fats have no flavors of their own, e.g. carrying vitamins A, D, E and K from our foods to our tissues.

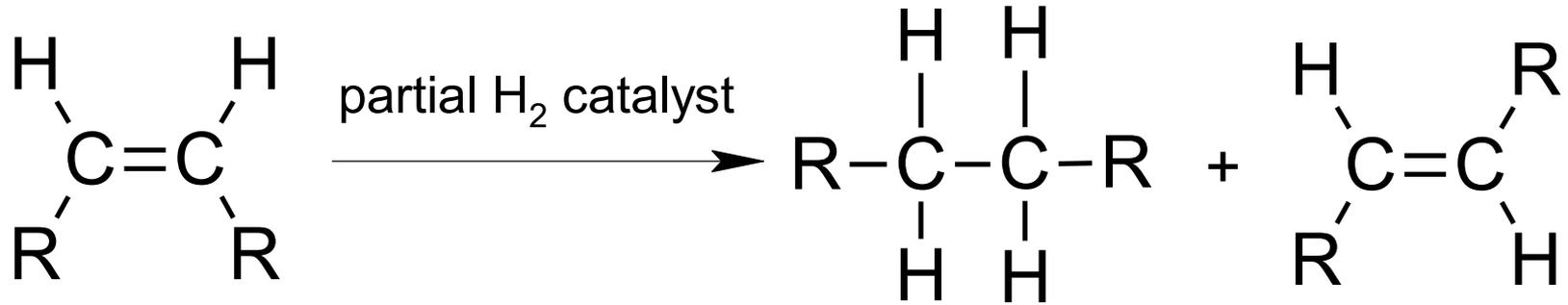
Fatty acids form not only the triglycerides but other compounds as well, including such vital classes as **prostaglandins** and **phospholipids**.

Cis vs. Trans Fatty acids



- Almost all natural unsaturated fatty acids have cis stereochemistry in C=C's.
- Small amounts of trans are produced in stomachs of ruminating animals by partial enzymatic hydrogenation of polyunsaturated fats, and thus are present in small amounts in milk and butter.

Commercial Hydrogenation of Fatty Acids



'cis'
unsaturated
natural
good

saturated
natural
bad

'trans'
unsaturated
unnatural
bad