



**SNS COLLEGE OF ALLIED HEALTH SCIENCES**

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**DEPARTMENT OF CARDIAC TECHNOLOGY**

**COURSE NAME : BIOCHEMISTRY**

**TOPIC : LIPIDS**

**FATTY ACIDS – DEFINITION AND CLASSIFICATION**



# Fatty Acids

- A fatty acid generally consists of a straight chain of an even number of carbon atoms, with hydrogen atoms along the chain length and at one end of the chain and at the other end of a carboxyl group (-COOH)
- Important component of lipids, building blocks of fat in the body.
- During digestion, the body converts fats into fatty acids, which are then absorbed into the bloodstream.
- Fatty acid molecules are typically joined in groups of three to form a molecule known as a triglyceride
- When glucose (a type of sugar) is unavailable for energy, the body turns to fatty acids to power the cells.

Nomenclature ← **FATTY ACIDS** → Functions

**Classification**

**Chain length**

- ↳ Short- **2-6**
- ↳ Medium- **8-14**
- ↳ Long- **14-24**
- ↳ Very long- **>24**

**Total carbon atoms**

- ↳ Odd chain
- ↳ Even chain

**Nature of chain**

- ↳ Saturated
- ↳ Unsaturated
- ↳ Branched
- ↳ Hydroxy

**Synthesis in body**

- ↳ Essential
- ↳ Non-essential



- Fatty acids are classified:

Based on chain length,

Based on the content of total carbon atoms

Based on saturation vs unsaturation,

Based on synthesis in body



# Fatty Acid Length

- **Short-chain fatty acids (SCFA)** are fatty acids containing upto 6 carbon aliphatic tails (e.g. [butyric acid](#)).
- **Medium-chain fatty acids (MCFA)** are fatty acids with 6 to 12 carbon aliphatic tails that are capable of forming medium-chain triglycerides.
- **Long-chain fatty acids (LCFA)** are fatty acids containing from 13 to 21 carbon aliphatic tails.
- **Very long-chain fatty acids (VLCFA)** are fatty acids of 22 or more carbons with aliphatic tails.



# Based on the total number of carbon atoms



## 1. Even and Odd Chain Fatty Acids

- Most naturally occurring fatty acids have an even number of carbons in their aliphatic chain.
- Example: oleic acid, stearic acid.
- However, some fatty acids also have an odd number of carbons in their chain.
- They are known as odd-chain fatty acids (OCFA).
- Example: heptadecanoic and pentadecanoic acid that are found in dairy products.
- The biosynthesis of odd chain fatty acids is a little more complex than the even chain fatty acids.



# Based on their degree of saturation/unsaturation in the carbon chain



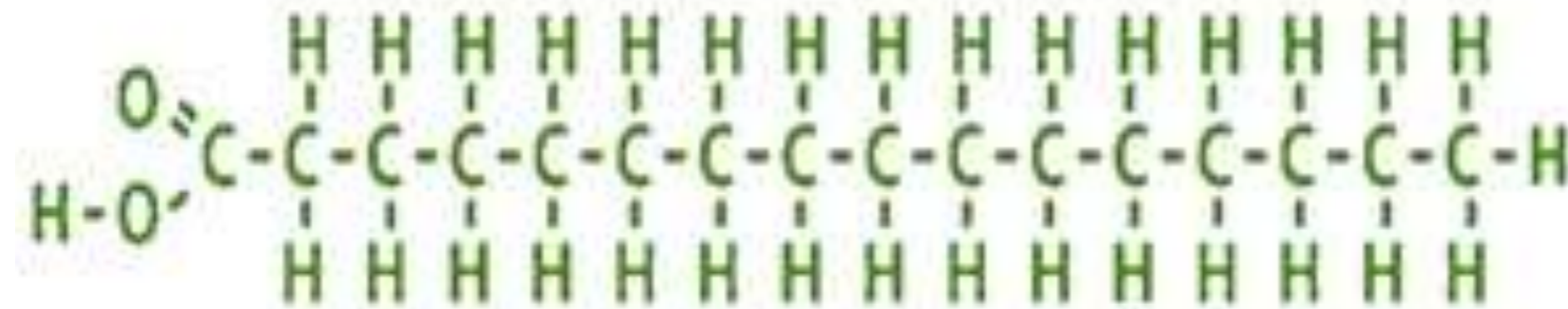
- If there is no double bond, the fatty acid is saturated.
- If there is one double bond, the fatty acid is monounsaturated,
- If there are two or more double bonds, the fatty acid is polyunsaturated.

Furthermore, they can be divided into two broad classes based on the presence or absence of double/triple bonds:

- If there are no double bonds in the carbon chain, it is saturated.
- If there are one or more double bonds in the carbon chain, it is unsaturated.



- **Saturated fatty acids**
- It consists of single C-C single bonds.
- These molecules fit closely together in a regular pattern and strong attractions between fatty acid chains.
- These fatty acids have high melting points, which makes them solid at room temperature.
- Examples of saturated fatty acids are palmitic acid and stearic acid.







- **Unsaturated fatty acids**

- Unsaturated fatty acids are the fatty acids that consist of one or more C=C double bonds. Eg: Crotonic acid, Palmitoleic acid and Oleic acid.

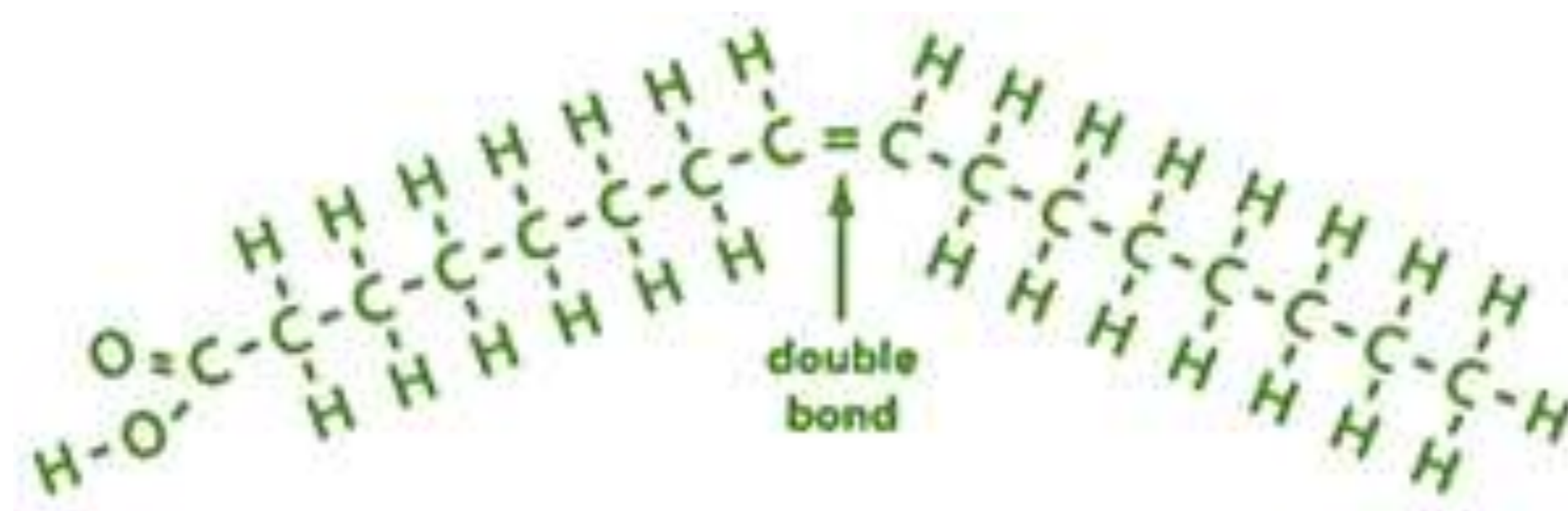
An unsaturated fatty acid is divided into two types.

- Mono polyunsaturated fatty acids.

Example: oleic acid.

- Polyunsaturated fatty acids.

Example: linoleic acid.





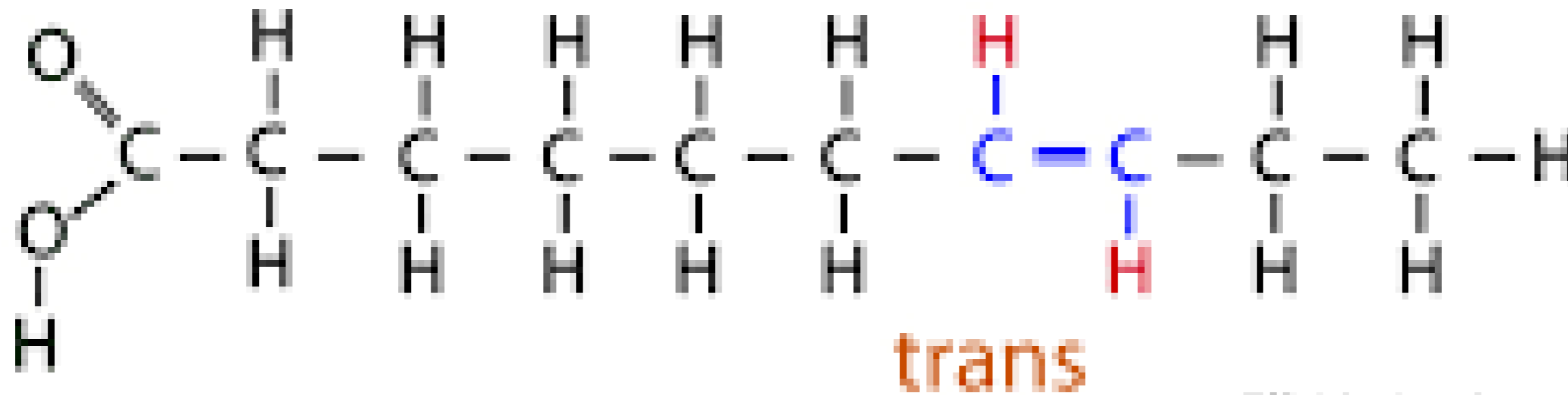
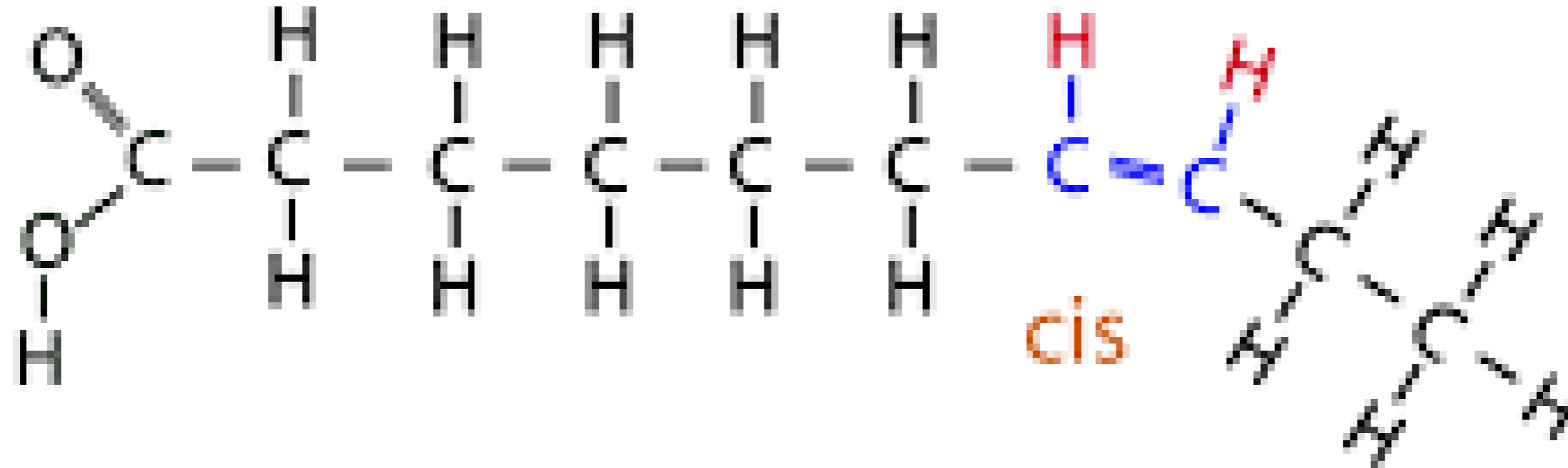
# Cis and Trans Fatty Acids



- The term "cis" and "trans" describe the positions of the two hydrogen atoms located next to the carbon atoms where the double bond exists.
- The key difference between cis and trans fatty acids is that:
  - The **cis fatty acids** have two hydrogen atoms attached to the double bond in the **same side** of the carbon chain
  - Whereas **the trans fatty acids** have the two hydrogen atoms bonded to the double bond in the **opposite sides** of the carbon chain.



# Cis- and Trans-Fatty Acids



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# Monounsaturated fatty acids (MUFA)



- Are healthy fat molecules with one double bond fatty chain acids and remaining carbon atoms are single bonded.
- Plant oils rich in MUFA are liquid at room temperature and semisolid or solid when chilled.
- Natural food sources abundant in MUFA are dairy products, [nuts](#), seeds, olives and avocados.
- Sunflower oil contains 85% MUFA, while olive Oil has 75% and canola oil has 58%.
- Some of the other good sources of MUFA are almond, corn, sesame, peanut, grapeseed, safflower and whole grain wheat.



# Polyunsaturated fatty acids (PUFA)



- Are healthy lipid molecules which have two or more carbon-carbon double bonds.
- Oils rich in PUFA are liquid in room temperature, viscosity and melting point temperature increases inversely to double bond.
- Good sources of PUFA are walnut, sunflower seeds, flaxseeds and poppy seeds.
- **PUFA are of two types omega 3 fatty acids and omega 6 fatty acids.**
- **Omega 3 fatty acids** are of 3 types linoleic acid, Eicosapentaenoic Acid and Docosahexaenoic Acid
- Abundant in fish, chia seeds, hemp seeds and flaxseeds.
- Rich sources of Omega-6 Fatty Acids are oils of palm, soybean, rapeseed, and sunflower.
- Foods abundant in omega-6 fatty acids are eggs, whole grain foods, nuts, pumpkin seeds, pine nuts, walnuts.



# Clinical Significance of MUFA and PUFA



- **Omega 3 fatty acids** possess strong anti-inflammatory properties which lower risk of heart disease, Alzheimer's, promotes vision and boost brain health.
- MUFA improves insulin levels and keeps blood sugar under control.
- Prevent hyperglycemia, hypoglycemia and prediabetes symptoms.
- Regular usage of MUFA lowers the bad cholesterol, improves the level of good cholesterol.
- Omega 3 fatty acids rich in PUFA promote mood, depression, [anxiety](#) and normal fetal development.
- Helps in cell and nerve maintenance and aid in digestion.



## Based on synthesis in body



- **Essential Fatty Acids:**

Fatty acids that cannot be produced or synthesized in our bodies are called essential fatty acids.

- These fatty acids need to be taken through a diet to fulfil the body's requirement for different metabolic functions.
- It includes linoleic acid, linolenic acid, and arachidonic acid.

- **Non-essential Fatty Acids:** Non-essential fatty acids include those lipids that are synthesized by our body.
- They are not needed to be taken through any outside food source.
- It includes palmitic acid, oleic acid, and butyric acid.



## Other classes of fatty acids

- **Oxygenated fatty acids**

They contain hydroxyl, keto, and epoxy groups; an example is ricinoleic acid, the major fatty acid in castor oil.

- **Cyclic fatty acids**

They contain a cyclic unit with three, five, like prostaglandins, or even six carbon atoms.





# Uses of Fatty Acids



- They are used in the production of many food products.
- In the production of soaps, skin care products, detergents, and cosmetics contain sodium and potassium salts - which can help maintain the appearance and function of healthy skin.
- Emulsifiers, texturizing agents, wetting agents, anti-foam agents, and stabilising agents are all examples of fatty acids.
- Excessive dietary fat intake has been linked to increased risk of obesity, coronary heart disease and certain types of cancer.
- High consumption of saturated-fatty acids is widely considered a risk factor for cardiovascular disease.



# Assessment



1. What are fatty acids?
2. Classify the fatty acids based on 4 types?
3. Differentiate saturated and unsaturated fatty acids?
4. Differentiate cis and trans fatty acids?
5. Mention the uses of fatty acids?



**THANK YOU**