SNS COLLEGE OF ALLIED HEALTH SCIENCES

SNS Kalvi Nagar, Coimbatore - 35

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DEPARTMENT OF CARDIO PULMONARY PERFUSION CARE 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.

FATTY ACIDS

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 occuring 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

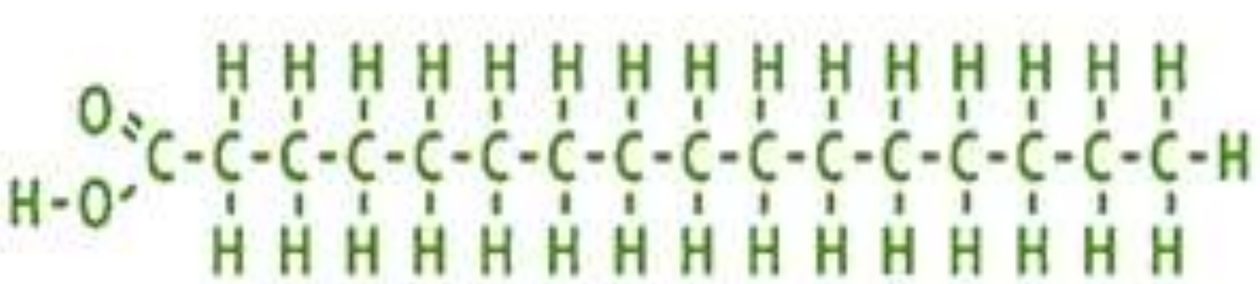
- If there is no double bond, the fatty acid is saturated.
- If there is one double bond, the fatty acid is monounsaturated,
- If there are two or more double bonds, the fatty acid is polyunsaturated.

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.

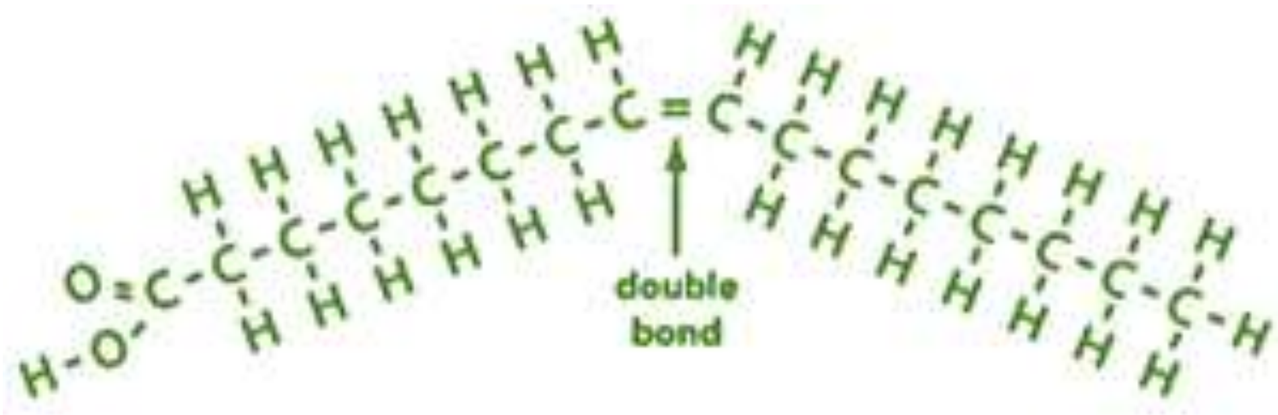
An unsaturated fatty acid is divided into two types.

- Mono polyunsaturated fatty acids.

Example: oleic acid.

- Polyunsaturated fatty acids.

Example: linoleic acid.

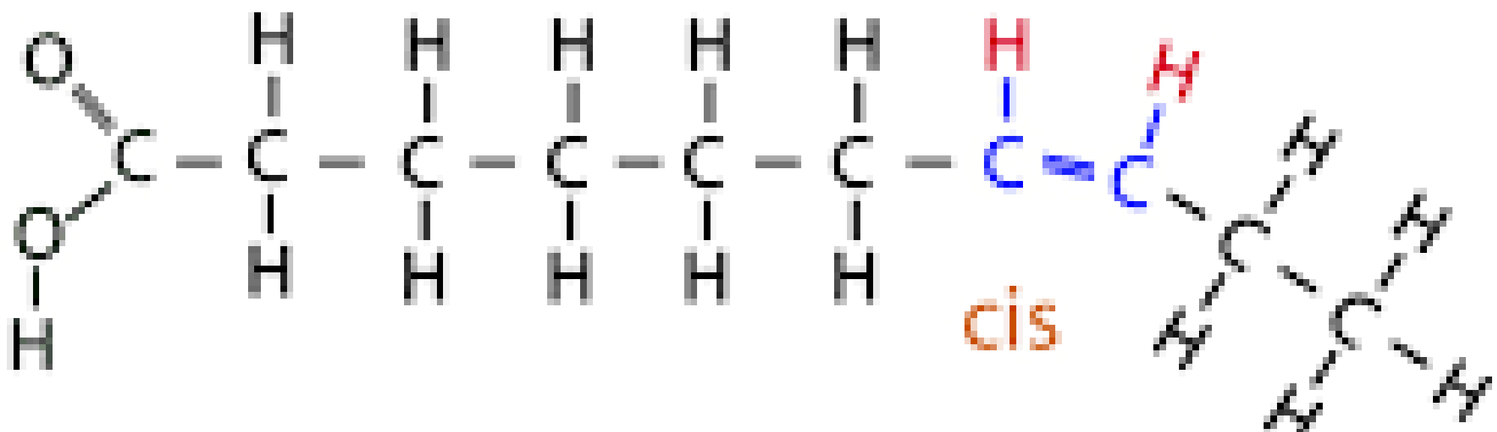


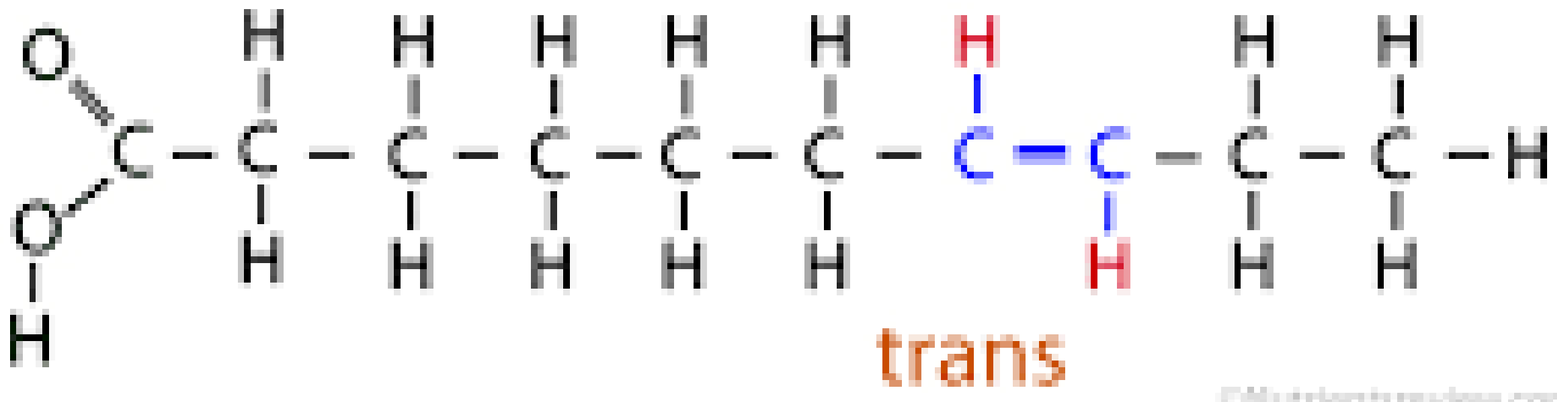
Cis and Trans Fatty Acids

- 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





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