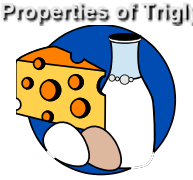
Lipids

Types of Lipids
Fatty Acids
Fats, and Oils
Chemical Properties of Triglycerides



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Types of Lipids

- Lipids with fatty acids
  - Waxes
  - Fats and oils (triglycerides)
  - Phospholipids
  - Sphingolipids
- Lipids without fatty acids
  - Steroids

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Fatty Acids

- Long-chain carboxylic acids
- Insoluble in water
- Typically 12-18 carbon atoms (even number)
- Some contain double bonds

corn oil contains 85% unsaturated fatty and 14% saturated fatty acids

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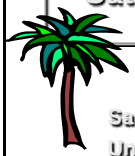
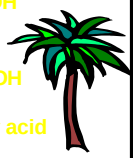
Saturated and Unsaturated Fatty Acids



Saturated = C–C bonds
Unsaturated = one or more C=C bonds

palmitic acid, a saturated acid

palmitoleic acid, an unsaturated fatty acid



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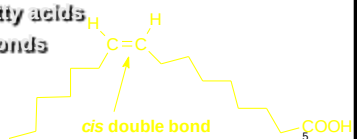
Structures

Saturated fatty acids
- Fit closely in regular pattern

Unsaturated fatty acids
- Cis double bonds



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Properties of Saturated Fatty Acids

- Contain only single C–C bonds
- Closely packed
- Strong attractions between chains
- High melting points
- Solids at room temperature

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Properties of Unsaturated Fatty Acids

- Contain one or more double C=C bonds
- Nonlinear chains do not allow molecules to pack closely
- Few interactions between chains
- Low melting points
- Liquids at room temperature

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Learning Check

How would the melting point of stearic acid compare to the melting points of oleic acid and linoleic acid? Assign the melting points of –!7°C, !3°C, and 69°C to the correct fatty acid. Explain.

stearic acid (!8 C) saturated

oleic acid (!8 C) one double bond

linoleic acid (!8 C) two double bonds

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Fats and Oils

Formed from glycerol and fatty acids

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Triglycerides (triacylglcerols)

Esters of glycerol and fatty acids

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Learning Check

What are the fatty acids in the following triglyceride?

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Properties of Triglycerides

Hydrogenation

- Unsaturated compounds react with H_2
- Ni or Pt catalyst
- C=C bonds → C–C bonds

Hydrolysis

- Split by water and acid or enzyme catalyst
- Produce glycerol and 3 fatty acids

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Hydrogenation

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Product of Hydrogenation

Hydrogenation converts double bonds in oils to single bonds. The solid products are used to make margarine and other hydrogenated items.

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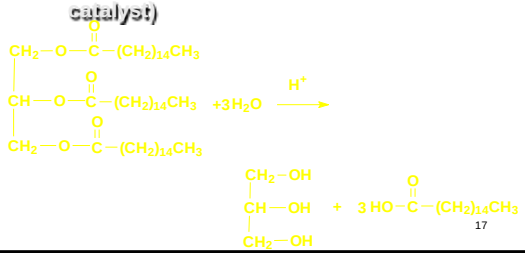
Hydrolysis

Triglycerides split into glycerol and three fatty acids (H^+ or enzyme catalyst)



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Saponification and Soap

- Hydrolysis with a strong base
- Triglycerides split into glycerol and the salts of fatty acids
- The salts of fatty acids are "soaps"
- KOH gives softer soaps

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Saponification

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Learning Check

What are the products obtained from the complete hydrogenation of glyceryl trioleate?

(1) Glycerol and 3 oleic acids
(2) Glyceryltristearate
(3) Glycerol and 3 stearic acids

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