Oleochemistry

The fundamental concept of Oleochemistry

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The students should be able to understand and updating:

- **Fats and oils as oleochemical raw materials**

  - feedstock from animal fats

  - feedstock from plant oils

  - other feedstocks

- **Fats and oils compositions, properties and specifications**

Feedstock for Oleochemical

- Animal fats (renewable raw materials)
- Vegetable oils (renewable raw materials)
- Their use avoids the upstream pollution associated with petroleum extraction and refining
- They are readily biodegradable, low in toxicity and do not harm aquatic organisms compare with petrochemicals

Fats and Oils

- Fats and oil are water insoluble, hydrophobic substances.
- Mainly derived from of vegetables & fruits, land or marine animal
- Predominant composition = **triacylglycerols**.
- Also contain other minor glyceride fractions = **diacylglycerols**, **monoacylglycerols** & **free fatty acids**.
- Other non-glyceride fractions = phosphatides, sterols, carotenoids, & other types of fatty alcohols.

Fats and Oils (cont.)

- Different temperatures can change a fat to different states from solid to liquid.
- Thus, **FATS** are defined as those that are **solid** at room temperature while **OILS** are those that are **liquid** at room temperature.

Fats and Oils Composition

1. **GLICERIDES**
   - Triglycerides 90 – 98 %
   - Diglycerides 0.2 – 8 %
   - Monoglycerides 0.2 – 0.3 %
   - Fatty acids 0.2 – 10% (Saturated / Monosaturated/ Polysaturated)

2. WATER 0 – 0.3 %

3. IMPURITIES 0.1%

4. POLAR LIPIDS

- Phospholipids 0.1 – 3%
- Glycolipids 0.1 – 3%

5. UNSAPONIFIABLE

- Sterols 0.3 – 0.7%
- Tocopherols 0 – 0.1%
- Pigments
  - Carotena 0 - 0.1%
  - Chlorophylle

Triglycerides

- The different placement of FA and FA types attached to the glycerol molecule leads to a number of different TAG
- Affect phycisal properties, the stability of the oils and fats

Fatty Acids

- Saturated fatty acids- Short ($C_{2:0}$- $C_{4:0}$) medium ($C_{6:0}$- $C_{12:0}$) and long chain fatty acids ($C_{14:0}$- $C_{22:0}$)
- Unsaturated fatty acids- monounsaturated and polyunsaturated

Feedstock from Animal Fat

- Derived both from terrestrial and marine animals
- Marine fats include liver oils, blubber oils, and fish oils

Feedstock from Animal Fat

- terrestrial animals include pig fat (lard), sheep/beef fat (tallow, suet), butter (clarified butter, ghee), poultry fat (chicken, duck, goose)

Feedstock from Plant Oils

- found abundance in fruits and seeds
- also found in the roots, stalks, branches, and leaves of plants
- Vegetable fats and oils may or may not be edible.
- E.g. of inedible vegetable fats and oils = processed linseed oil (flaxseed oil), tung oil, castor oil
- commonly used in lubricants, paints, cosmetics, pharmaceuticals, etc.

Feedstock from plant oils-

edible vegetable fats and oils

1. Palm oil
2. Palm Kernel oil
3. Coconut oil
4. Soybean oil
5. Rapeseed (Canola oil)
6. Sunflower oil
7. Corn (maize) oil
8. Olive oil
9. Cottonseed
10. Peanut oil
10. Sesame oil
11. Grapeseed oil
12. Rice bran oil
13. Safflower oil

PRODUCERS OF OILS AND FATS

ASIA

(mostly Malaysia, Indonesia, Phillipines)

Lauric acid ($C_{12:0}$) from palm kernel and Coconut oil

US & EUROPE

Animal fats

Palm Oil

- Extracted from flesh/mesocarp of palm fruit.
- Consists of ~ 44% palmitic acid
- Can be divided into the solid (stearin) and liquid (olein) fraction by fractionation at controlled temperatures
- Contain 50% unsaturates and 50% saturated FA

Fatty Acid Composition of Palm Oil

- **Unsaturated fatty acids**
  oleic acid ($C_{18:1}$): 38.7%
  linoleic acid (**$C_{18:2}$**): 10.5%

- **Saturated fatty acids**
  palmitic acid ($C_{16:0}$): 44%
  stearic acid (**$C_{18:0}$**): 4.6%
  myristic -saturated (**$C_{14:0}$**):1.0%

Rapeseed (Canola) Oil

- seed oil of *Brassica napus* or *B. campestris*
- typically rich in erucic acid (C 22:1)
- high erucic acid content can cause cardiac muscle damage
- **Canola** is a genetic variation of rapeseed developed by Canadian plant breeders
- **Canola** is an acronym for "Canada oil low acid".
- **Canola** is the registered name for rapeseed containing
  - < 2% of erucic acid in the total fatty acids in the oil

Fatty Acid Composition of Rapeseed Oil

- **Unsaturated fatty acids**

  oleic acid ($C_{18:1}$): 62%

  linoleic acid ($C_{18:2}$): 22%

  linolenic acid ($C_{18:3}$): 10%

- **Saturated fatty acids**

  palmitic acid (**$C_{16:0}$): 4%**

  stearic acid ($C_{18:0}$): 2%

Sunflower oil

- obtained from *Helianthus annuus*
- contains 60-75% of linoleic acid
- **Sunola (Highsun)** comes from a high-oleic variety and has about 85% oleic acid
- **NuSun** with ~ 60% oleic acid has been developed in the USA

Fatty Acid Composition of Sunflower Oil

- **Unsaturated fatty acids**

  linoleic acid ($C_{18:2}$): 48 - 74%

  oleic acid ($C_{18:1}$): 14 - 40%

- **Saturated fatty acids**

  palmitic acid ($C_{16:0}$): 4 - 9%

  stearic acid ($C_{18:0}$): 1 - 7%

Castor oil

- Native to the Ethiopian region of tropical east Africa .- Other tropical and warm temperature regions
- Seeds or beans are extremely poisonous. Contain ricin a very deadly protein called a lectin
- Known as ricinus oil, yellowish or almost colourless. Has been used medicinally in the US
- When dehydrated, it converted into a quick-drying oil . Used extensively in paints and varnishes
- Its water resistant qualities make it ideal for coating fabrics

Tung oil

- Known as China Wood Oil
- Seed rich in unsaturated oils. When drying it absorb oxygen from the air to form plastic, elastic, resin-like substancesIt is a drying oil which has wide applications in the manufacture of paints, varnishes, waterproof coatings and artificial rubber.
- Composed primarily of eleostearic acid

Tall Oil

- Know as liquid odorous obtained as by-product of pulp and paper industry from pine wood rosin, is a dark yellow
- It is composed of a mixture of rosins, fatty acids, sterol, alcohols and other non acid materials
- Use as a component of soap, adhesives, rubbers, inks and as emulsifier, linoleic and palmitic acids
- Main fatty acid oleic

Conclusion

- The fundamental of the oleochemicals are mainly on the raw materials.
- The main contents especially the fatty acids in oils and fats from vegetables and animals are presented.

Chapter description

All pictures/photographs/diagrams/figures used in this chapter is subjected to common creative that for education purposes