Lecture 23
Oil Crops

World Production of Oils—30 billion lb./yr

Annual Trade

10 billion lb. vegetable
(soy, cotton, peanut, safflower, sesame, olive)
3 billion lb. palm oil
5 billion lb. industrial
(flax, castor, rapeseed, tung, crambe)
2 billion lb. marine [whale, fish (herring)]
10 billion lb. animal fats (tallow, lard)

Annual Consumption of Fats in US

Dietary: 40 lb./person
Industry: 60 lb./person

Cooking

Shortening: 100% fat
Salad oils: 100% fat
Emulsifiers: 50–100% fat
Margarine: 80% fat
Processed foods: 1–10% fat

Industrial

Paints
Lacquers
Synthetic fibers
Oil cloth
Hydraulic fluids
Resins
Medicinals

Varnishes
Plastics
Linoleum
Lubricants
Soaps
Cosmetics
Fatty Acids

<table>
<thead>
<tr>
<th>No.</th>
<th>Saturated</th>
<th>Mono-unsaturated</th>
<th>Polyunsaturated</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (butter)</td>
<td>butyric</td>
<td>caproic</td>
<td>arachidonic*</td>
</tr>
<tr>
<td>6</td>
<td>caproic</td>
<td>caprylic</td>
<td>oleic</td>
</tr>
<tr>
<td>8</td>
<td>caprylic</td>
<td>palmitoleic</td>
<td>linoleic*</td>
</tr>
<tr>
<td>10</td>
<td>palmitoleic</td>
<td>stearic</td>
<td>linolenic</td>
</tr>
<tr>
<td>12 (laural)</td>
<td>stearic</td>
<td>oleic</td>
<td>linolenic</td>
</tr>
<tr>
<td>14 (momi)</td>
<td>oleic</td>
<td>palmitic</td>
<td>linolenic</td>
</tr>
<tr>
<td>16 (palm)</td>
<td>linolenic</td>
<td>palmitoleic</td>
<td>linolenic</td>
</tr>
<tr>
<td>18 (tallow)</td>
<td>linolenic</td>
<td>arachidonic*</td>
<td>linolenic</td>
</tr>
<tr>
<td>20</td>
<td>arachidonic*</td>
<td>arachidonic*</td>
<td>linolenic</td>
</tr>
</tbody>
</table>

*essential to human nutrition

Oil: Glycerides of Fatty Acids = glycerol + fatty acids

Oil—Liquid at room temperature
Fat—Solid at room temperature

Wax: Fatty esters (fatty acid + alcohol)
Liquid or solid at room temperature
Carnuba wax—a palm in Brazil
Jojoba wax—a substitute for sperm whale oil

Carnuba wax palm
Manufacture of Soap

\[
\text{OH} \quad \text{HOOCC-R} \quad \text{OH} \quad \text{OH}
\]

Glycerol \quad \text{Fatty acids}

\[
\begin{array}{c}
\text{O} \\
\text{11} \\
\text{O-C-R} \\
\text{11} \\
\text{O-C-R} \\
\text{11} \\
\text{O-C-R} \\
\end{array}
\]

\[
+ 3\text{H}_{2}\text{O}
\]

\[
\text{NaOH}
\]

\[
\text{Na}+\text{OOC-R}
\]

\[
\text{soaps}
\]

Fats in Nutrition

Provides calories
Fat = 9 kcal/g
Carbohydrates = 4 kcal/g
Protein = 4 kcal/g

Source of fat soluble vitamins: A,D,E,K
Provide essential fatty acids: linoleic, arachidonic
Saturated fats, trans fats, considered unhealthy.
Oil Classification

Nondrying: remains liquid
Semidrying
Drying: forms films

Nondrying Oils

Coconut  Palm kernel  Butter (saturated)

Semidrying Oils

Soy  Cotton  Corn  Peanut  Safflower
Drying Oils

Linseed

Rapeseed

Tung (polyunsaturated)

Castor

Polymerization

Conjugated diol bond system - diol bonds alternate

Energy, heat, uv, etc.

Polymerization

Rancidity

Addition of oxygen between double bonds results in compounds with off flavors. Prevented by the use of antioxidants.
Oil Processing

- Extraction
  - pressing, solvents

- Refining (without shell)
  - soap stock

- Hydrogenation (of acid oil)
  - R2+H6 catalyst

- Bleaching
  - removal & pigments w/ activated charcoal

- Deodorization
  - steam carries away odors

- Finishing oil
  - antioxidants, food colors, mixed, inoculated or other oils for M.P.