

Ethnobotany. Lecture 10

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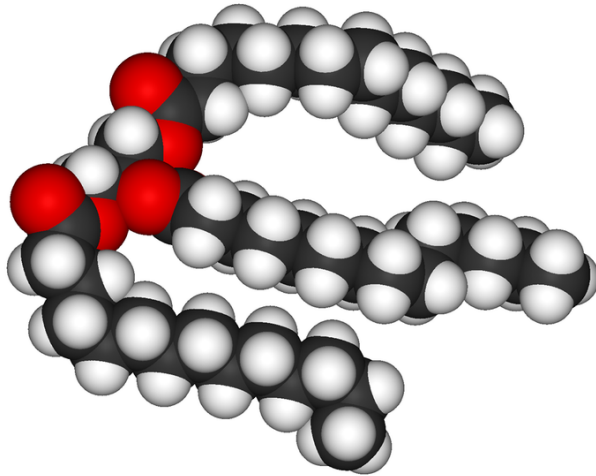
Outline

- 1 Oil plants
 - Introduction
 - Sunflower, *Helianthus annuus*
 - Peanut, *Arachis hypogaea*
 - “Canola”, rapeseed, *Brassica napus*

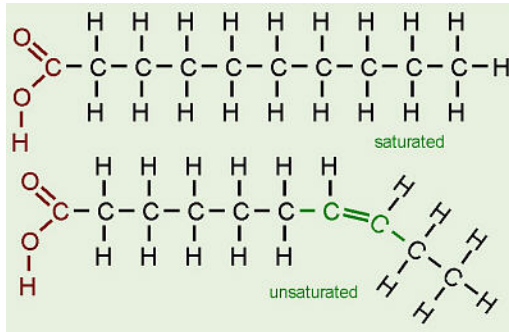
What are oils

- Triglycerides: triesters of glycerol and saturated or non-saturated fatty acids
- Liquid triglycerides are oils whereas hard are fats
- Hydrogenated oils are hard derivatives of liquid plant oils

Triglycerides



Fatty acids



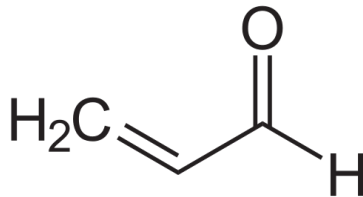
Oils features

- High energy: 9 calories per gram, two times more than carbohydrates or proteins
- Slow metabolism, several times slower than of carbohydrates

Smoke temperatures

- Under high temperatures, oils start to smoke: this is due to acrolein
- Acrolein is highly toxic (even used as chemical weapon in World War I)
- Cream butter has $\approx 175^{\circ}\text{C}$ smoke point whereas many plant oils like peanut have $\approx 250^{\circ}\text{C}$ smoke point; flax oil is an exception ($\approx 107^{\circ}\text{C}$)

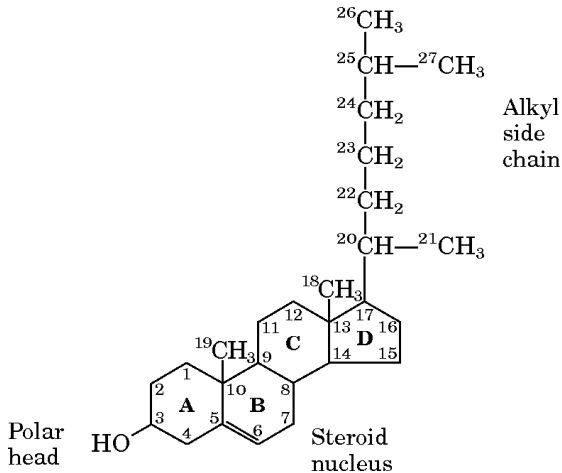
Acrolein



Cholesterol

- Cholesterol is a main component of membranes and predecessor of steroid hormones
- However, suspicions raised that high level of cholesterol corresponds with atherosclerosis (Ancel Keys' conception of "Mediterranean diet")
- Recent experiments suggest that cholesterol level has only weak relation with vessel diseases
- Plant oils do not contain cholesterol

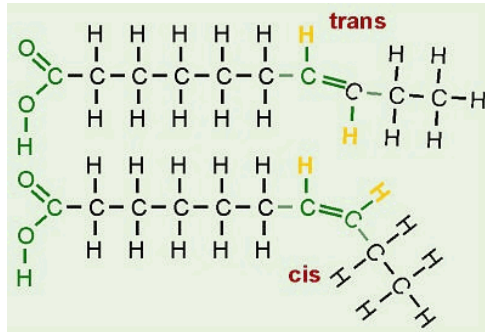
Cholesterol



Trans fats

- Trans fats are products of hydrogenation of plant oils, they also may appear in deep fat frying
- Again, suspicion is that trans fats are related with heart diseases
- Now most of hydrogenated oils (margarines) are almost free of trans fats

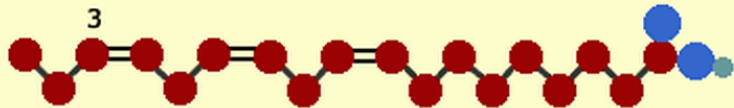
Trans fatty acids



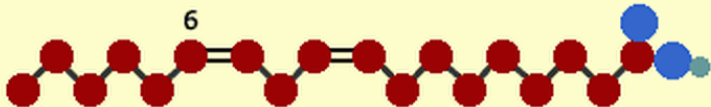
Omega-n-unsaturated fatty acids

- Essential fatty acids that may only be synthesized in plants
- They *probably* related with lowering of cholesterol level, with curing Type 2 diabetes, and with general lowering of cardiovascular mortality
- Canola, flax and soybean oils contain significant amounts of omega-3-unsaturated fatty acids (and also sea fishes)

Omega-n-unsaturated fatty acids



Alpha-Linolenic acid (omega 3)



Linoleic acid (omega 6)

Sunflower, *Helianthus annuus*

- Belongs to aster family, Asteraceae
- Big genus distributed in North and South (but not Central) Americas
- Only one species, *Helianthus annuus* is cultivated

Sunflower biology

- Annual plant (exception among sunflowers!)
- Young plants are Highly heliotropic
- Up to 65% of oils in seeds
- Used also as forage plant, especially in northern regions
- Coordinates of flowers in the head are explained with Vogel's model:

$$r = \sqrt{n}; \quad \theta = n \times 137.5^\circ,$$

where where θ is angle, r is the distance from the center, n is the index number of the floret, and c is a constant.

Sunflower head



Sunflower agriculture

- Requires light and aerated, rich soils; root system allows to use water from deep layers of soil; requires phosphorus
- Vegetation period 70–140 days
- Wind- and insect-pollinated plant
- Oil is pressed similarly to most oil plants
- There are also nut cultivars

Sunflower history

- Domesticated most probably in North America, widely used by native tribes in New Mexico and other southern states
- Went to Europe in 1510, cultivated as ornamental and forage plant and then abandoned
- In Russia, folk selection resulted in fasciated cultivars which have several times more seeds per head
- In 1859, cultivation started again, now as an oil plant (Bokarev discovered the high oil content)
- Ukraine, Germany and United States are now main producers
- Symbol of Ukraine, state flower of Kansas

Fasciation



Peanut, *Arachis hypogaea*

- Belongs to legume family, Leguminosae
- Geocarpic plants: fruits are burying into the ground
- One of the most protein-rich oil plants (53% oils, 25% proteins)

Peanut biology

- Small, self-pollinated plant with flowers positioned nearby soil surface
- Burying structure is a gynophore, part of flower receptacle
- Legumes are indehiscent, contain 2–3 seeds
- 1–2% of population have peanut allergy (consequence of high protein content)

Peanut



Peanut agriculture

- Vegetation is 3–5 months
- Requires warm temperatures, average humidity (500–1,000 mm) and light, sandy soils
- As a legume, does not need many fertilizers
- Susceptible to fungus contamination in storage: some fungi produce toxic *aflatoxin*

Peanut history

- Cultivated species is a tetraploid originated from hybridization of two South American wild species
- In valleys of Peru, cultivated from 5,600 BC
- In XVII century, went independently to Africa and Asia
- Biggest producers now are China, India and U.S. Main crop in several West African countries, e.g., Ghana.
- Hundreds of cultivars, in U.S. there are mostly “Runner” and “Virginia” groups

“Canola”, rapeseed, *Brassica napus*

- “Canola” stands for “**can**adian oil”, name of the group of cultivars of rapeseed, *Brassica napus* from cabbage family, *Cruiferae*
- One of the most hardy oil plants
- New culture, only in 1970s started to be used widely

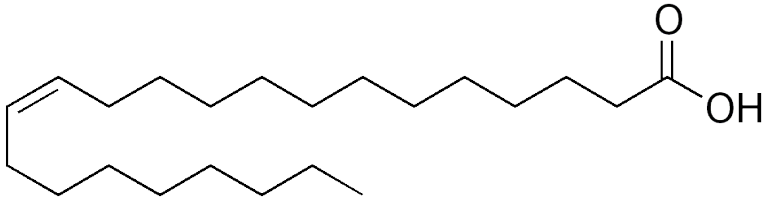
Canola



Canola biology

- Medium-sized (up to 1.5 m tall) herbaceous annual, cultivated as winter or as spring crop
- Seeds contain high amounts of unsaturated oils including omega-3 oils
- Cross-pollinated, produces significant amounts of nectar
- Non-canola cultivars contain toxic erucic acid and glucosinolates

Erucic acid



Canola agriculture

- Relatively easy culture, requires water and cool temperatures, long-day plant
- Needs high amounts of fertilizers
- Harvesting should be fast because siliques are dehiscing fast

Canola siliques



Canola history

- Domesticated in Europe
- Cultivated for a long time but mostly as technical oil plant
- In 1974, zero-rapeseed was selected which contained less than 2% of erucic acid; in 1982, 00-rapeseed which contains almost 0% of erucic acid: canola
- Canola cultivars are susceptible for fungal diseases (erucic acid was a defense agent)
- Canola also susceptible to cross-pollination with technical rapeseed
- Biggest producers now are China, Canada and India

Summary

- All oil plants contain oil (non-saturated triglycerids) in seeds
- The most oil characteristics are smoke temperature, amount of cholesterol, amount of trans fats and omega-n-unsaturated fatty acids

For Further Reading



A. Shipunov.

Ethnobotany [Electronic resource]. 2011—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_310



P. M. Zhukovskij.

Cultivated plants and their wild relatives [Electronic resource].

Commonwealth Agricultural Bureaux, 1962.

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http://ashipunov.info/shipunov/school/biol_310/zhukovskij1962_cultivated_plants.pdf

Pages 16–23.