

Ethnobotany. Lecture 12

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Outline

- 1 Oil plants
 - “Canola”, rapeseed, *Brassica napus*
 - Olive, *Olea europaea*
 - Sesame, *Sesamum indicum*
 - Safflower, *Carthamnus tinctorius*
 - Oil palm, *Elaeis guineensis*
 - New oil cultures
 - Lesser oil plants
 - Technical oil plants



Oil plants

“Canola”, rapeseed, *Brassica napus*



“Canola”, rapeseed, *Brassica napus*

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



Canola

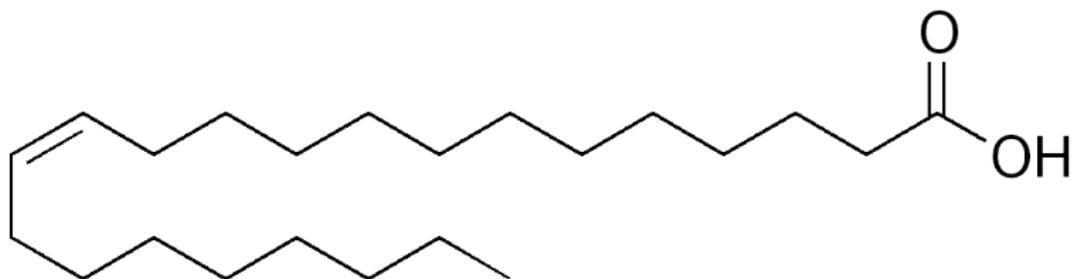


Canola biology

- 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 potentially toxic erucic acid and glucosinolates
- Erucic acid, however, is used as four-to-one mixture with oleic acid and constitutes "Lorenzo's oil" (there is a movie with same name); an experimental treatment for the rare neurobiology disorder adrenoleukodystrophy



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



Oil plants

Olive, *Olea europaea*



Olive, *Olea europaea*

- One of the oldest oil plants, also used as vegetable
- Belongs to olive family, Oleaceae
- Relatively hardy plant despite of evergreen life form



Olive biology

- Evergreen, long-lived (up to 2,000 years), small tree
- Starts to produce fruits from 3–4 year (when grafted)
- Cross-pollinated with wind
- Oil does not contain omega-n-unsaturated fatty acids



Olives in Greece



Olive agriculture

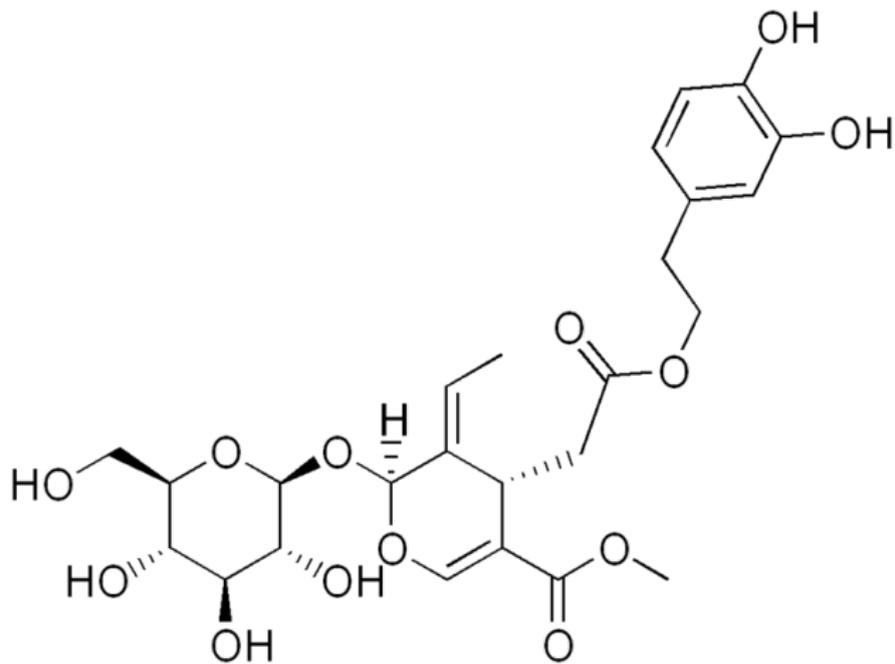
- Requires dry air and lots of sun, does not particular to soils (but grows better on limestone soils)
- One tree may produce ≈ 20 kg of fruits per year for 200 years
- Harvested in winter, half-manually, by shaking trees
- Oil is pressed, outer parts are fermented to remove bitter *oleuropein*



Olive harvesting



Oleuropein



Olive history

- Large historical and mythological background: from Old Testament and Greek mythology to Quran
- Cultivation started > 6,000 BC in Mediterranean
- More than 500 cultivars; top producers are Spain, Italy and Greece
- Olive became invasive in Australia



Oil plants

Sesame, *Sesamum indicum*



Sesame, *Sesamum indicum*

- Belongs to the tropical genus *Sesamum* (≈ 20 species) from sesame family, Pedaliaceae
- The oldest cultivated oil plant



Sesame



Sesame features

- Tropical herbaceous annual plant, vegetation 3–4 month, yield is 1–2 tons/hectare
- Seeds contain 50-65% of oil; oil contains phytosterols, vitamin E and significant amounts of microelements, especially iron and magnesium
- Can grow in dry climatic zones
- Used entirely (green mass as a forage, pressed cakes in bakery etc.)



Fruits and seeds of sesame



Sesame history

- Cultivation started in India prehistorically, went to ancient Egypt and then to Europe
- Now cultivated mostly in tropics around the world
- Biggest producers are still India and China
- Famous also after Ali-Baba story from “One thousand and one nights”



Ali-Baba (40 thieves are not at home yet)



Oil plants

Safflower, *Carthamnus tinctorius*



Safflower, *Carthamnus tinctorius*

- Belongs to Mediterranean *Carhtamnus* (distaff thistles) genus and atser family, Compositae
- Highly ornamental cultivated plant
- Multiple uses: as oil plant, as medicinal plant and as saffron substitute (red dye)



Safflower field

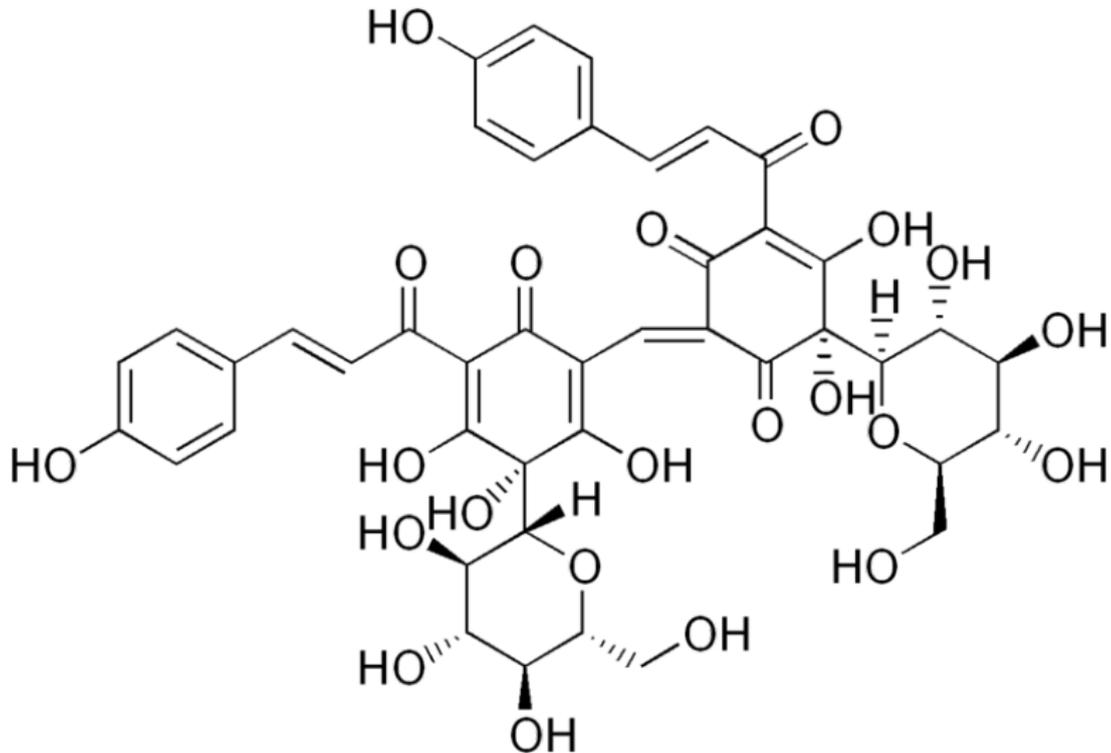


Safflower features

- Achenes contain 15–35% of oil
- Oil contains mono- and polyunsaturated fatty acids, and therefore may be used for painting (fast-dried oil)
- Flowers contain carthamin which produces a red-brown color, often used in food production
- Rich of tokoferols (vitamin E)



Carthamin



Safflower history

- One of the most ancient cultivated plants, used in Old Egypt
- Went to Japan and used there as a plant which dye had ceremonial meanings



Harvesting safflower



[From Takahata's "Only yesterday" movie]



Making Japanese clothes



Painted with safflower



Shuntei (1898): *Shadow of the Castle*



Oil plants

Oil palm, *Elaeis guineensis*



Oil palm, *Elaeis guineensis*

- Used in Africa from prehistorical times, but the mass cultivation started only in the beginning of XX century
- Belongs to palm family, Palmae
- Palm oils are semi-solid at the room temperature: plant fats



Fruits of oil palm



Blocks of palm oil



Oil palm features and history

- Oil is rich of saturated fatty acids, especially palmitic (C₁₆) acid, also rich of carotenes and often has a reddish color
- Yield is high (up to 100 kg of oil from one tree per year), and therefore palm oil is very common in tropics
- Biggest producers are Malaysia and Indonesia
- Also famous as the source of Greek fire and **napalm** (mixture of palmitic acids, several other organic compounds and aluminum)



Making of palm oil (Kongo)



Napalm



Oil plants

New oil cultures



Sacha inchi, *Plunkettia volubilis*—perspective oil plant

- South American, Amazonian tree from spurge family, Euphorbiaceae
- Capsules contain several large seeds, rich of oil ($\approx 60\%$)
- Sacha inchi oil contains highest amounts of omega-n-unsaturated fatty acids (93%!) and vitamin E
- Cultivation started in 2000s, mostly in Peru



Sacha inchi



Oil plants

Lesser oil plants



Coconut, *Cocos nucifera*

- Belong to Palmae, cultivated around the world as technical and nut plant
- Oil is similar to Africal oil palm: rich of saturated fatty acids, especially lauric acid (48%)
- Oil extracted from either coconut milk (wet process), or copra (dry process)
- Apart from food, has a wide technical use (lubricant, fuel, cosmetics)

[Coconut palm will be covered in more detail later]



Drying coconut copra for oil making



Soybeans, *Glycine max*

[The plant was covered earlier]

- Apart from protein food, soybeans produce one of most widely used cooking oil (“vegetable oil”), with high smoke point (232°C)
- Soybean oil is rich of poly-unsaturated fatty acids (especially 2-unsaturated linoleic, 51%)
- Soybean oil may also be used for painting (because it is drying slowly), as insect repellent, as fuel, and as fixative to essential oils



Soybean oil



Soubean oil as biofuel



Flax, *Linum usitatissimum*

- Obtained from flax (*Linum usitatissimum* from Linaceae family) which is also used as technical plant
- Bright yellow, very fast drying oil because it is rich of triply unsaturated fatty acid, α -linolenic acid (up to 55%), smoke point is low (107°C)
- Normally, used as a technical substance for painting, for finishing wood, for linoleum (one of the first half-synthetic floor covering) and also as rich and useful food supplement (α -linolenic acid = ω -unsaturated acid, EFA)

[The plant will be covered in more details later]



Wood finishing with flaxseed oil



Cottonseed, *Gossypium* spp.

- Extracted from seeds of cotton (several species of *Gossypium* from Malvaceae family)
- Oil contains up to 52% stearic (monounsaturated) fatty acid, very stable (does not dry) and with high smoke point (232°C) (Rice oil has the highest smoke point, 254°C)
- Used in many foods, especially for salad dressings and chips, for deep frying
- High of tokoferols (vitamin E)
- Contain amounts of *gossypol*—biologically active phenolic compound which may be used in medicine (e.g., as contraceptive, for curing viral infections etc.) but should be removed from food oil

[Mostly known as a fiber plant, will be covered later]



Cottonseed oil



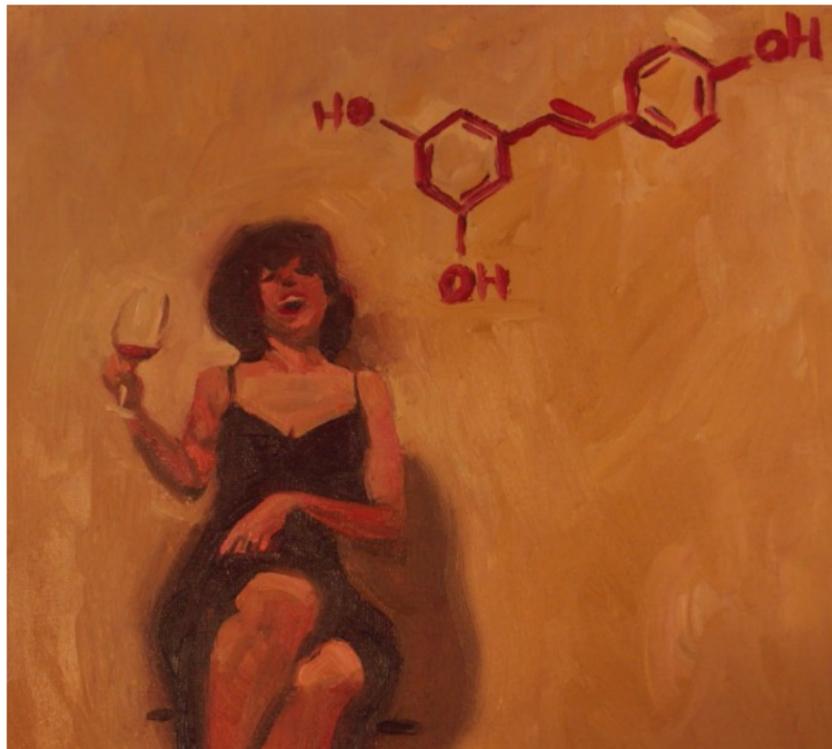
Grapeseed, *Vitis vinifera*

- By-product of winemaking, extracted from grape (*Vitis vinifera* from Vitaceae family)
- Similarly to soybean oil, rich of 2-unsaturated linoleic acid (72%)
- Used similarly to cottonseed oil: salad dressings and deep frying
- Has high medicinal value: contains *phytoalexin* (plant non-specific immune chemical) **resveratrol** (also component of red wine) which is anti-cancer and anti-hypertensive drug

[Mostly known as fruit, will be covered later]



Resveratrol



Cocoa butter, from *Theobroma cacao*

- Cocoa butter from *Theobroma cacao* (Malvaceae family) is plant fat, rich on non-saturated fatty acids (stearic and palmitic together $\approx 60\%$)
- Has 37°C melting temperature and therefore used a lot as a subsidiary oil in medicine (e.g., in suppositories) and in cosmetics; also used for making white chocolate
- Normally, does not contain theobromine and caffeine (components of dark chocolate)

[The plant will be covered in more details later]



Cocoa flower



Oil plants

Technical oil plants



Essential oils

- Mixture of hydrophobic components bearing plant odors
- Used for aromatherapy and in cosmetics
- The most famous are probably rose oil and eucalyptus oil

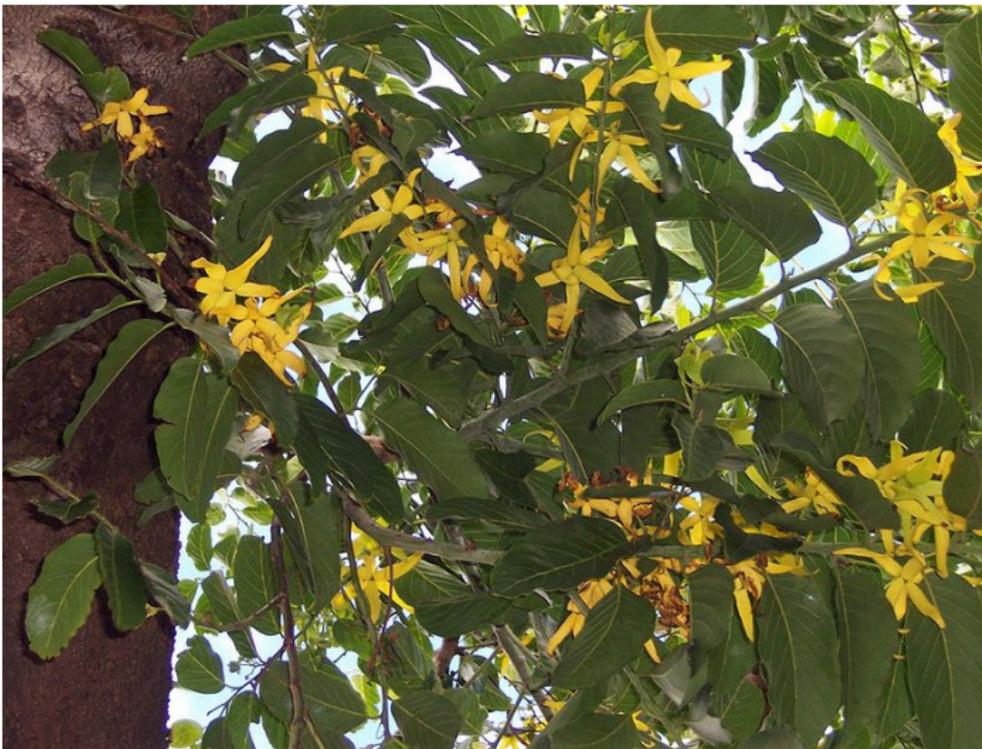


Ylang-ylang, *Cananga odorata*

- Tree from custard apple family (Annonaceae) which is cultivated for perfume oil
- Fast-growing tree from Indonesia
- Has diverse medical applications, used for cosmetics and in aromatherapy
- Comoros is the biggest exporter of ylang-ylang (29% of its annual export)



Ylang-ylang



Camphor tree, *Cinnamomum camphora*

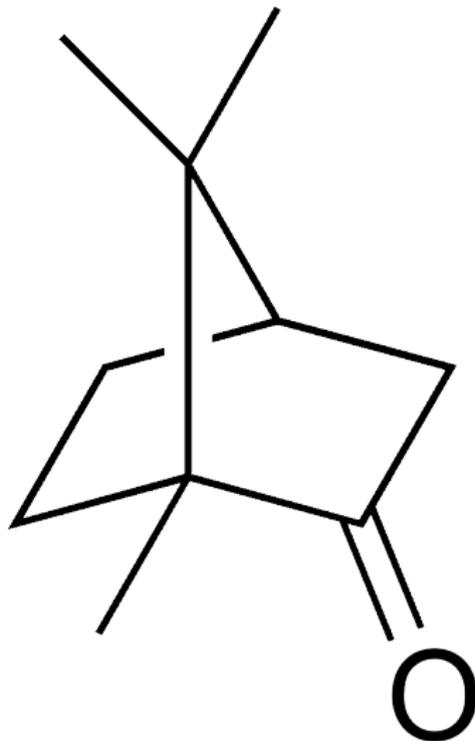
- East Asian tree from laurel family, Lauraceae
- Contain multiple aromatic substances, e.g., camphor—unusual hydrophobic molecule
- Camphor use has the old history, it still has a high ceremonial value in Hinduism, used in sweets, for aromatherapy and in fireworks (highly flammable)
- It is a Totoro tree from H. Miyazaki's "My neighbor Totoro" anime film



Camphor tree



Camphor: chair molecule



Totoro on the top of camphor tree



Summary

- 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
- Oil palm and cocoa tree produce high amounts of plant “fats”
- The most promising contemporary oil cultures are canola and sacha inchi



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.

Mode of access:

[http://ashipunov.info/shipunov/school/biol_310/
zhukovskij1962_cultivated_plants.pdf](http://ashipunov.info/shipunov/school/biol_310/zhukovskij1962_cultivated_plants.pdf)

Pages 16–27.

