Frankincense and Myrrh: A History Up in Smoke

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Outline



History and historical importance Identities of frankincense and myrrh Biological properties and chemistry of plant resins Hello to the Burseraceae Geography and convergent evolution of the plants Geography and convergent evolution of their uses

History and historical importance

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Egypt

* In 2800 B.C. King Isesi sent expeditions to Eritrea



for incense; other expeditions to the region in 2100 & 2000 B.C.
* Ca. 1550 B.C., frankincense mentioned in the Egyptian Book of the Dead; frankincense considered the sweat of the gods fallen to

earth.

- * 2ndC B.C. Queen Hatshepsut went to Eritrea and brought back *Boswellia papyrifera* and *Commiphora "erythraea"* (note taxonomic problems).
- * True frankincense and myrrh came later, from the other side of Straits of Aden in Arabia.
- * Used in mortuary rituals, ceremonial purification, warding off evil.

Greece

Alexander the Great (d. 323 B.C.) sent Anaxicrates to Yemen and Oman to determine the sources of frankincense and myrrh (recorded by Theophrastus in 295 B.C.)

Rome

Estimated that during 1st Century A.D., Rome imported 2,500-3,000 tons of frankincense and 450-600 t of myrrh; early deficit spending!



Censers, 3rd C B.C.

The earliest records of the collection of frankincense and the trade in the gum are shrouded in an often impenetrable mantle of myth and magic; for example, the precious gum-bearing trees were said to be guarded by fierce red snakes (probably North East African Carpet Vipers, Echis pyramindum pyramidum or Echis *khosatzkii*), which leapt into the air to inflict their fatal bites on any intruder; or the trees were believed to grow in an area of swirling mists, the cause of deadly disease and fatal epidemics.



from Miller & Morris, Plants of Dhofar (1988)



Bahla Fort, Oman 12th -15th C







Frankincense in Dhofar (Oman), X/2014







Photos by Darach Lupton











Identities of frankincense and myrrh





The correct scientific name for the Arabian plants has for a long time

been rather confused. The first scientific collection of specimens from an Arabian frankincense tree was made in 1846 by Dr. H. J. Carter at Rakhyut. Carter was surgeon aboard the East India Company's survey ship *Palinurus* which surveyed the Southern Arabian coast. At the time, he incorrectly named his specimen B. serrata, a known Indian species. In 1867 a Swiss chemist and botanist Flüchiger re-examined Carter's specimens and described them as a new species, B. sacra. Three years later in 1870, the English botanist Birdwood revised the whole genus and considered Carter's specimen to the same as material from Somalia which he described as *B. carteri* -- a name which was for a long time misapplied to the Arabian plants. Recent research has shown that the African plants (under the name *B. carteri*) and the Arabian plants all belong to the same species which must be called by the oldest name --Boswellia sacra. from Miller & Morris, Plants of Dhofar (1988)



Boswellia sacra – "true" frankincense











Commiphora myrrha – "true" myrrh

Properties and chemistry of plant resins

Protium (Burseraceae) Pará, Brazil



A timeline of useful resins:

- * 1000 B.C. Egyptians prepared mummies using storax (*Liquidambar*), mastic (*Pistacia*), & Aleppo (*Pinus*) resins (Carthage mummies from same period used sandarac (*Tetraclinis*))
- * 350 B.C. Praxiteles used resins for polishing sculptures
- * Early Christian era: Frankincense cited in Syriac Book of Medicine, also in Indian and Chinese medical writing
- * 11thC A.D., Theophilus described making varnish
- * 12-13thC, Chinese texts tell of 13 kinds of frankincense
- * 15thC, Rembrandt reportedly used amber varnish in oil paints (16thC, da Vinci ditto)
- * 1863 linoleum invented by Frederick Walton (and the rest is history...)



The kauri story



FIGURE 2. ADATHIS ALBA (ALMACIDA). THE BOURCE OF MANILA COPAL #3. DESTI-___2

Uses of frankincense in Dhofar (Oman)

- * Forgetfulness
- * Hysteria
- * Strengthen teeth and gums
- * Treat nausea of pregnancy
- * Pomade to remove bags under eyes
- * Hemorrhoids
- * Pessary to encourage conception
- * Pollen remedy for gout

* Buds and fruits for sore throat

- * Underbark used as dye
- * Chew root for stomach ailments
- * Toothache
- * Candles
- * Fractures
- * Repair cracked ceramics
- * Smoke as curative & protective

Some of the commercial uses of plant resins inks lacquers linoleums varnishes paints plastics sizing polishes coatings adhesives waxes turpentine perfume engraving/lithography perfumes baking enamels...

Terminology

- Confusion: *gums* as latex & resin; latex paint contains resins;
 BUT rubbers (condoms) contain latex (rubber). . .
- Latexes and resins are related, but not gums; still, gums and resins can be in the same exudate, e.g., myrrh (an oleo-gum-resin).
- All are combinations: myrrh is 2/3 H₂O-soluble gums, and rubber is 40% resins.

Adapting the functions of exudates in the plant

- Mechanical, i.e., wound sealing (mastic for sealing teeth; gutta for sealing root-canal work)
- Also vehicles for secondary metabolites (chitinases, podophyllotoxins, vinca alkaloids, ojé, taxol, etc.)





Building blocks





Number of isoprene units	Carbon number	Name or class	Main types and occurrence
1	C ₅	isoprene	detected in Hamamelis japonica leaf
2	C ₁₀	monoterpenoids	monoterpenes in plant essential oils (e.g. menthol from mint) monoterpene lactones (e.g. nepetalactone) tropolones (in gymnosperm woods)
3	C_{15}	sesquiterpenoids	sesquiterpenes in essential oils sesquiterpene lactones (especially common in Compositae) abscisins (e.g. abscisic acid)
4	C_{20}	diterpenoids	diterpene acids in plant resins gibberellins (e.g. gibberellic acid)
6	C_{30}	triterpenoids	sterols (e.g. sitosterol) triterpenes (e.g. β-amyrin) saponins (e.g. yamogenin) cardiac glycosides
8	C40	tetraterpenoids	carotenoids* (e.g. <i>β</i> -carotene)
n .	\mathbf{C}_n	polyisoprene	rubber, e.g. in Hevea brasiliensis

Table 3.1 The main classes of plant terpenoids

*C₅₀-based carotenoids are known in some bacteria.











Linalool – a monoterpenoid

The original source was the Mexican species *Bursera linanoe* (syn.: *B. delpechiana*), which was cultivated on large plantations in India until synthetic linalool was developed. The resin was harvested from trees deliberately damaged and then felled.

Uses of linalool (Wikipedia): Linalool is used as a scent in 60–80% of perfumed hygiene products and cleaning agents including soaps, detergents, shampoos, and lotions. It is also used as a chemical intermediate. One common downstream product of linalool is Vitamin E. In addition, linalool is used by pest professionals as a flea and cockroach insecticide.

Linalool is used in some mosquito repellent products, however the EPA notes that: "A preliminary screen of labels for products containing Linalool (as the sole active ingredient) indicates that efficacy data on file with the Agency may not support certain claims to repel mosquitos."





Bursera linanoe

a plantation in India

Anatomy of a resource





Cross-sections of a woody stem (1) and a pine needle



Anatomy and resin harvesting



Figure 1. Schematic overview of current techniques for harvesting exudates in South-East Asia. (The small arrow indicates the direction of subsequent tappings) – 1, Agathis, Canarium; 2, Pinus; 3, Dipterocarpus, Shorea, Sindora; 4, Styrax; 5, Madhuca, Palaquium, Payena; 6, Hevea brasiliensis; 7, Dyera (Ficus elastica); 8, Dyera (Ficus elastica).

Hello to the Burseraceae, a good example of a pantropical family



Bursera sp., one of 48 spp in the state of Guerrero, México

A monstrous *Canarium* in Bogor, Indonesia





Boswellia serrata (India) – cousin of frankincense



A-E. Balsamodendron Ehrenbergramum Bg F-L. Balsamodendron Gileadense Kunth

Commiphora spp. – cousins of myrrh





Geography and convergent evolution









Convergence – where am I?







Convergence – who am I?





Geography and convergent evolution of their uses





medicinal plant stand, Manaus, Brazil

Throughout its geographic range, the resin of Burseraceae is used for rituals, illumination, medicine, and as a sealant.

resin of *Bursera* sp. collected on a leaf of *Agave* in Mexico.

Protium heptaphyllum wounded to produce resin used in *candomblé* ceremonies in Bahia, Brasil

Dacryodes excelsa

Martinique – the Trace des Jésuites

Madagascar – *Canarium &* bull's blood

Thanks