www.cropwatch.org

THE FIRST TRULY INDEPENDENT WATCHDOG FOR THOSE WORKING WITH NATURAL AROMATIC MATERIALS

E: info@cropwatch.org T: ++44 (0)7771 872 521

Frankincense – A Brief Catch-Up.

[Slightly corrected & modified from a feature first published on www.aromaconnection.org 1st Jan. 2009, and later as a feature in *Cropwatch Newsletter* Jan. 2009].

The year 2008 saw the publication of a number of papers on the analysis & therapeutic properties of Frankincense gum, extracts & distillates, and it is only in recent years perhaps, that we are gaining further insight into the true nature & therapeutic potential of the various types of exudations & preparations. The whitish-yellow or yellow-orange tears or lumps of Frankincense gum (syn. Olibanum) (syn. Incense) are obtained by tapping the trees of a number of *Boswellia* spp., and the gum & derivatives are valuable exported commodities for the Horn of Africa region (Djibouti, Ethiopia, Eritrea, Somalia & the island of Socotra (Yemen)), but also for Sudan and other African regions. Frankincense gum is used to prepare incense, and extracts & distillates have been widely used as fragrance ingredients. Indian, Arabian & African *Boswellia* spp. have a number of uses in local ethnic medicine, which is starting to translate into uses in evidence-based conventional medicine (see for example, the major feature on Frankincense & derivatives in *Phytomedicine*, June 2008).

For a working definition, we can say that Frankincense is the dried exudation obtained from the schizogenous gum-oleoresin pockets in the bark of various *Boswellia spp* - the *Boswellia* group itself being placed within the *Burseraceae* family. The *Boswellia* group constitutes some 25 species of shrubs or small trees found in the dry tropical areas of N.E. Africa, S. Arabia and India (including N.E. Tanzania and Madagascar) growing at a height of 1000 to 1800 m. :

***Boswellia* Species.**	**Eritrea**	**Ethiopia**	**Somalia**	**Sudan**	**India**	**Kenya**	**Oman**	**Nigeria**
Boswellia bhau-dajiana* Birdw.			√					
***B. dalzielii* Hutch.**								√
***B. frereana* Birdw.**			√				√	
***B. microphylla* Chiov.**		√						
***B. neglecta* S. Morre**		√	√			√		

B. ogadensis **Vollesen**		√						
B. papyrifera **(Del.) Hochst**	√	√		√				
B. pirottae **Chiov.**		√						
B. rivae **Engl.**		√	√					
B. sacra Flück **		√	√				√	
B. serrata Roxb.					√			

Table 1. Distribution of some *Boswellia* spp.
*some now say syn. *B. sacra* Flück ** **syn. *B. carteri* Birdw.**

As indicated in Table 1, the botanical origins of Aden and Ethiopian brands of Frankincense are popularly regarded as originating from *Boswellia serrata* Roxb. and B. *frereana* Birdwood, respectively, whereas Sudanese and Indian olibanum are considered to originate from *Boswellia papyrifera* Del. and *Boswellia serrata* Roxb.

Survival Pressure on *Boswellia* spp.

Several *Boswellia* spp. are listed in the IUCN Red List of Threatened Species 2008, including several individual spp. from the island of Socotra, off Yemen:

Boswellia aff. ameero Vulnerable D2 - native to Socotrana
Boswellia ameero Vulnerable B2ab(ii,iii) - native to Socotrana
Boswellia bullata Vulnerable D2 - native to Socotrana
Boswellia dioscorides Vulnerable D2 - native to Socotrana
Boswelia elongata Vulnerable B2ab(iii) - native to Socotrana
Boswellia nana Vulnerable D2 - native to Socotrana
Boswellia ogadensis Vulnerable D2 -only from 1 river location in Ethiopia.
Boswellia pirottae LR/nt - only from 3 river locations in Ethiopia
Boswellia popoviana Vulnerable D2 - native to Socotrana
Boswellia sacra LR/nt - native to Oman, Somalia & S. Yemen.
Boswellia socotrana Vulnerable D2 - native to Socotrana

Of the above, probably only *B. sacra* is of any significant commercial importance. However, the IUCN does not list other Frankincense-yielding species of commercial importance which would also appear to be under severe threat e.g. *Boswellia papyrifera* in Eritrea, Ethiopia & Sudan (for more detail, see Cropwatch's *Updated List of Threatened Aromatic Plants Used in the Aroma & Cosmetic Industries v1.10* Jan. 2009). The results of the analysis of the essential oils from three threatened *Boswellia* species of the eight endemic to Socotra, have recently been published (Awadh Ali *et al*. 2008). Curiously, the authors do not mention the threatened status of the species studied.

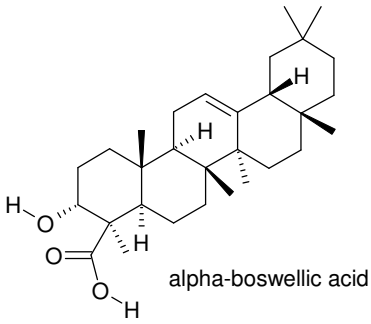
Frankincense – Uses.

Frankincense has been very highly valued for thousands of years, dating to pre- Roman times, and has many uses & applications. It is the Horn of Africa's highest volume export, and apart from uses in incense/perfumery, the gum oleoresin & preparations thereof are also used for embalming & in a number of medicinal systems (as a stimulant, repiratory antiseptic, diuretic, emmenagogue) for flavourings ('maidi' type of frankincense preferred) & for skin cosmetic applications for toner, emollient & anti-wrinkle uses.

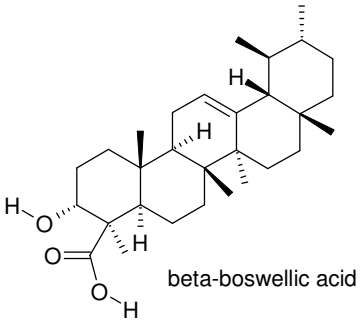
In perfumery frankincense (as olibanum oil) is used as a fixative & for fresh balsamic, dry, resinous, somewhat green note in Oriental bases, ambers, florals, colognes, male fragrances etc.

Frankincense - Anti-inflammatory Effects.

Given the use of Indian Frankincense (*B. serrata*) gum-oleoresin in treating inflammatory disease in Ayervedic medicine, a number of researchers have investigated the anti-inflammatory & anti-arthritic effects of the *Boswellia* resins, especially looking at the alcohol soluble components of the resins (the 'boswellic acids'). Some Frankincense extracts contain α- and β-boswellic acids from 3α-hydroxy-olean-12-en-24-oic acid and 3α-hydroxy-urs-12-en-24-oic acid respectively, amongst others.



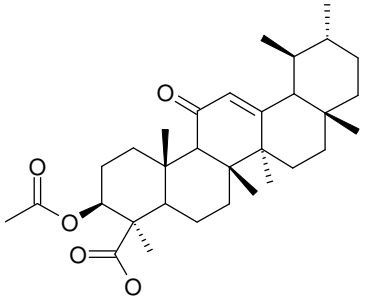
alpha-boswellic acid



beta-boswellic acid

Boswellic acid & pentacyclic triterpene acids are marketed as anti-inflammatory & anti-arthritic drugs in India (Handa 1992). However, Basar (2005) investigating the acidic fractions of *Boswellia* spp., concluded that *B. carteri* & *B. serrata* only had boswellic acids in content Examples of commercialised products containing boswellic acids include 'H15' and 'Sallaki'. Another, 'Boswellin' (a patented product of Sabinsa Corporation) is described as the standardized ethanol extract of *Boswellia serrata* gum resin, containing 60% to 65% boswellic acids. Sandhika, a drug used in Ayervedic medicine, is a water extract of *Boswellia serrata*, *Commiphora mukul*, *Strychnos nux vomica* & *Semecarpus anacardum* and has been shown to demonstrate anti-oxidant activity *in vitro* through free-radical scavenging (Chaurasia *et al*. 1995).

The mechanism of the anti-inflammatory action may occur via the inhibition of 5-lipoxygenase (and hence leukotriene biosynthesis: Ammon *et al*. 1993; Ammon 1996). This action taken together with inhibition of human leukocyte elastase (Safayhi *et al*. 1997) may constitute the basis of the anti-inflammatory effect, since both of these enzymes play key roles in inflammatory & hypersensitivity-based diseases. The most active inhibitor of 5-lipoxygenase seems to be acetyl-11-keto-beta-boswellic acid, which is also cyctotoxic to meningioma cultures (Park *et al*. 2000).



acetyl-11-ketoboswellic acid

The use of *Boswellia* preparations to treat another inflammatory disease, ulcerative colitis, may also owe its beneficial action to 5-lipoxygenase inhibition (Gupta *et al.* 1997).

Anti-carcinogenic Effects.

Leading on from the above, extracts of *B. serrata* & boswellic acids & their derivatives have been investigated by a number of researchers for their (chemopreventive) anti-carcinogenic/anti-tumorigenic effects via their cytotoxic & apoptosis effects in various *in vitro* cell lines. In particular acetyl-11-keto-beta-boswellic acid shows strong cyto-toxic activity against meningioma cell-lines and is the strongest 5-lipoxygenase inhibitor yet tested amongst triterpenoids (Hostanska *et al.* 2002). See Cropwatch's *Frankincense Bibliography* v1.02 Jan 2009 for further details.

Use in Treating Respiratory Disease.

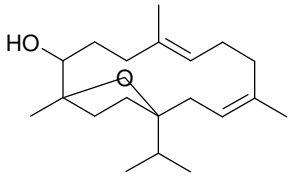
Gupta *et al*. (1997) investigated the use of *Boswellia serrata* gum resin in patients with bronchial asthma in 23 males & 17 females with a history of the disease, in a double-blind, placebo-controlled, 6-week clinical study, 70% of the patients showed an improvement (against a 27% improvement in the control group).

Incense: the Purifying Smoke.

The smoke of incense is traditionally used in Arabia & NE Africa for its deodorizing and purifying effects. Basar (2005) showed that the pyrolysates of *Boswellia carterii* & *B. serrata* resins showed anti-bacterial inhibition for contained certain substances e.g. 24-norursa-3,12-diene, incensole acetate & cembrene A, in the case of *B. carterii.* The author concluded that the results could support the successful use of certain *Boswellia* resins as a disinfectant in traditional ceremonies.

Analysis.

The literature is beset with analytical investigations of non-botanically verified frankincense samples, often obtained from local markets. Variations in the composition of essential oils distilled from the gum can occur from climatic, storage, species-dependent & geographic factors. The Eritrean type of Frankincense from *B. carteri* is typically characterized and set apart by the presence of up to 60% of n-octyl acetate, and the presence of cembrene type diterpenoids. It has been suggested that n-octanol & n-octyl acetate are the cause of the acrid smell when this material is burnt as incense (Basar 2005). The Indian oil from *B. serrata* is rich in α-pinene (to 45%: Oberman 1977) although α-thujene may predominate in some oils. The presence of sesquiterpenes in *B. serrata* sets it apart from many other Frankincense oils. The oil from *B. frereana* has p-cymene as principal component (Strappaghetti *et al.* 1982). A few papers have been published more recently where proper botanical identification has been established. One such paper is that of Hamm *et al.* (2005) who analysed the mono- sesqui- & di-terpene contents of 6 olibanum samples of botanically certified origin. For example the characteristic chemical compounds of *Boswellia papyrifera* were stated as the diterpenic biomarkers incensole and its oxide and acetate derivatives, n-octanol and n-octyl acetate.



incensole

A paper by Al-Harrasi & Al-Saidi (2008) investigating the essential oil from the gum of botanically certified Omani Luban (*Boswellia sacra*) describes an oil high in monoterpenes where E-β-ocimene and limonene were the major constituents.

Sesquiterpene content was low, mainly consisting of β-caryophyllene. Significantly, diterpenes were absent.

Although the feature has not specifically discussed uses of Frankincense in aromatherapy, this much is clear from the above: that essential oils 100% derived from a given botanical & geographically identified source are likely to be important pre-determinants to any claimed beneficial effects of the essential oil.

References.

Al-Harrasi A. & Al-Saidi S.. (2008) "Phytochemical analysis of the essential oil from botanically certified oleogum resin of *Boswellia sacra* (Omani Luban)." *Molecules* **13**(9), 2181-9.

Ammon H, *et al.* (1993) "Mechanism of antiinflammatory actions of curcumine and boswellic acids." *J. Ethnopharmacol* **38**(2-3), 113-19.

Ammon H. (1996) "Salai guggal *Boswellia serrata* : from a herbal medicine to a non-redox inhibitor of leukotriene biosynthesis." *Eur J Med Res* **1**(8), 369-70.

Awadh Ali N.A., Wurster M., Arnold N., Teichert A., Schmidt J., Lindequist U. & Wessjohann L. (2008) "Chemical composition and biological activities of essential oils from the oleogum resins of three endemic Socotraen *Boswellia* species." *Rec. Nat. Prod.* **2**(1), 6-12

Basar S. (2005) *Phytochemical investigations on* Boswellia *species: Comparative studies on the essential oils, pyrolysates and boswellic acids of* Boswellia carterii *Birdw.,* Boswellia serrata *Roxb.,* Boswellia frereana *Birdw.,* Boswellia neglecta *S. Moore and* Boswellia rivae *Engl*. PhD Thesis, Universität Hamburg 2005.

Chaurasia S,, Tripathi F. Tripathi Y.S. & Chaurasia S. (1995) "Anti-oxidative and anti-inflammatory property of Sandhika. A compound herbal drug." *Ind. J. Exp. Biol*. **33**, 428-432.

Gupta I., Gupta V., Parihar A., Gupta S., Ludtke R., Safayhi H. & Ammon H. P. (1998). "Effects of *Boswellia serrata* gum resin in patients with bronchial asthma: results of a double-blind, placebo-controlled, 6-week clinical study." *Eur. J. Med. Res*. **3**, 511-514.

Hamm S., Bleton J., Connan J. & Tchapla A.(2005) "A chemical investigation by headspace SPME and GC-MS of volatile and semi-volatile terpenes in various olibanum samples." *Phytochemistry.* **66**(12), 1499-514.

Handa S.S. (1992) *Fitoterapia* **63**(10), 3.

Hostanska K., Daum G. & Saller R. (2002) "Cytostatic and apoptosis inducing activity of boswellic acid towards malignant cells in vitro." *Anticancer Research* **22**, 2853-62.

Gupta I., Parihar A., Malhotra P., Singh G. B., Ludtke R., Safayhi H. & Ammon H.P (1997) ". Effects of *Boswellia serrata* gum resin in patients with ulcerative colitis." *Eur. J. Med. Res*. **2**(1), 37-43.

Mikhaeil B.R., Maatooq G.T., Badria F.A. & Amer M.M.A. (2003) "Chemistry and immunomodulatory cctivity of Frankincense oil." *Z. Naturforsch*. **58c,** 230-238.

Obermann H. (1977) "Die chemischen und geruchlichen Unterschiede von Weihrauchharzen" *Dragoco Reports* **24**, 260-265.

Park Y.S., Lee J.H., Bondar J., Harwalakr J.A., Safayhi H. & Golubic M. (2000) “Cytotoxic action of acetyl-11-keto-β-boswellic Acid (AKBA) on meningioma cells.” *Planta Med.* **68**, 397-401.

Safayhi H., Rall B., Sailer E-R. & Ammon H.P.T. (1997) "Inhibition by boswellic acids of human leukocyte elastase." *Pharmacology* **281**(1), 460-463.

Strappaghetti G., Corsano S., Craveiro A. & Proietti G. (1982) "Constituents of Essential oil of *Boswellia frereana*." *Phytochem*. **21**, 2114-2115.