

Frankincense: festive pharmacognosy

In this article, Sarah Marshall explores the history and uses of frankincense

Carols and nativity plays lead us to believe that there were three kings bringing gold, frankincense and myrrh to the baby Jesus, even giving them names. But when the birth of Jesus is recounted in Matthew's gospel, no number, names or royal positions are given to the magi. Later references indicate that Jesus was likely to have been about two years old by the time of their visit and living in a house rather than a stable. The visitors did, however, bring gifts of gold, frankincense and myrrh.

There is some speculation as to who the magi were and where they came from. The Greek word *magoi* indicates they may have been members of the priestly caste in Persia (modern day Iran). Some theologians consider that they were followers of the cult of Zoroaster, a prophet who lived ca628–551BC.^{1,2} An intriguing explanation is that they were Babylonian astrologers who, having had contact with Jewish exiles, knew of the prophecies regarding the Jewish Messiah — that a star would portend the birth of a king.³ To Christians, the gifts that the magi brought are symbolic. Gold symbolises kingship and myrrh is associated with death and embalming (indicating the death Jesus would die). Frankincense is the symbol of deity, since it was burned in the Temple as an acknowledgement of God.²

WHERE IS FRANKINCENSE FROM?

Frankincense or *olibanum* is a plant product. It is an oleo-gum-resin yielded by several species of tree belonging to the *Boswellia* genus and the family Burseraceae, which is characterised by resin bearing ducts. There are some 15 members of this much revised genus, named after John Boswell, uncle of James Boswell the biographer of Samuel Johnson. These trees are short, with papery bark, star-like flowers and compound leaves. Only a few species produce the frankincense of commerce, the type and the quality of the resin depending upon its origin. *Boswellia sacra* grows in Oman, Yemen and Somalia, *B papyrifera* in tropical north east and west Africa, *B frereana* in Somalia and *B serrata* in India.^{4,5}

OMANI FRANKINCENSE

In Oman frankincense trees grow in the province of Dhofar in the south west of the country, adjacent to the Yemeni border. While living in the sultanate I was fortunate enough to visit the region. From the fertile coastal plains in the north east, where Muscat the capital lies, we cut through the mountains to emerge onto a flat gravel plain. We drove 700km in the searing heat through this barren landscape. The only vegetation was an occasional acacia tree, under which, being mad and English, we picnicked in 44C. The road perhaps had



Boswellia sacra trees growing in a wadi in Dhofar (author for scale)

three bends in it the whole way, and there were a similar number of small settlements along the route.

As we approached the end of our journey the desolate scenery became more lunar, with hillocks forming and a low cloud visible on the horizon. We began to climb slowly, passing through the clouds to emerge, spectacularly, onto a high green plateau covered in lush vegetation, with camels grazing on scented wild gladioli. The contrast with the gravel plain could not have been more astounding. This was Dhofar.

The province of Dhofar comprises, for the most part, the sparsely vegetated desert we had driven through. However, along the southern coast is a crescent-shaped mountain range, extending from the Yemeni border for some 290km. By an accident of topography these escarpments are blanketed during the monsoon season (June to September) in moisture-laden clouds, resulting in a narrow belt of woodland a mere 240km long and three to 30km wide, filled with plant-life unique to Arabia.⁴ It is in the dry zones of Dhofar, beyond the reach of the monsoon rain but still cooled by the monsoon winds, and in some of the wadis (or dry river beds) extending to the coast that frankincense trees are found.^{4,6}

These *B sacra* trees are up to five metres tall, either with a single or several trunks rising from the base, papery, peeling bark and densely tangled branches with leaves clustered at the ends. The Greek botanist

Theophrastus (ca372–287BC) and the Latin naturalist Pliny (23–79AD) gave eyewitness accounts of the cultivation and harvesting of frankincense, and the methods are largely unchanged.⁷ The trees, when cut, exude the oily gum resin, which is either scraped off the tree with an iron implement or collected on palm mats on the ground as it drips off, the latter producing the better quality resin. Harvesting begins in December, reaching a peak from March to May.⁵ The best quality resin is pale in colour, formed as opalescent tears 5mm to 25mm long. Indeed, the Arabic name for the resin is *lubān*, also the word for milk. Early authors referred to this as “male frankincense”, because it collected in lumps and hung on the tree like testicles. Resin that has been scraped off the bark is reddish.^{4,6}

Frankincense has numerous traditional, ceremonial and medicinal uses in Oman. Ceremonial uses include burning the incense at weddings and religious celebrations, and during the swearing of an oath or the solemnising of a contract. Frankincense is also used to ward off evil influences or sickness. Terracotta burners, whose design has not changed for centuries are often used. Dried frankincense resin may also be burnt to perfume hair, clothes or rooms. The scented smoke has a characteristic odour, which anyone familiar with Middle Eastern souks or Roman Catholic churches will recognise. The soot made from burning the resin can be collected and used as eye make-up or to soothe sore eyes. Other medicinal uses in Oman include chewing the resin when fresh and soft to strengthen teeth and gums, fill a carious tooth, or stimulate digestion. Omani frankincense has also been used topically as hair lacquer, as depilatory wax or to immobilise a broken

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limb by smearing it over a frankincense bark splint. The resin in poultice form can be used to treat mastitis or drunk, mixed with water, to improve memory.^{4,6}

FRANKINCENSE IN THE PAST

It is thought that frankincense may have been produced and traded in Oman for up to 6,000 years.⁸ It is difficult for us to imagine, but in its day frankincense commanded fabulous prices, equal to that of gold.⁴ In Dhofar the frankincense trade was of huge commercial importance, with some 7,000 tons per year being exported at the peak of the Roman era,⁸ sufficient to merit a trading depot, with a sheltered harbour on the coast.⁴ The resin was not only transported by sea but also by land. In 1991, archaeological excavations were carried out in the desert north of Dhofar and, using satellite images of the area, the expedition (led by Sir Ranulph Fiennes) discovered Ubar, a city mentioned in 'The Arabian nights'. This city was probably responsible for providing water for the animals and traders involved in transporting frankincense overland. Camel caravans would have taken the frankincense north to what we now call Egypt, Jordan, Syria, Iraq and Israel and then on to Greece and Rome.^{9,10}

The ancient Egyptians believed frankincense to be the sweat of the gods, fallen to earth. There was a legend about a strange and marvellous bird coming from the land of Punt (possibly Somalia or India) that bore frankincense in its talons. In later times this became the legend of the Phoenix, which built its nest from twigs of frankincense and other precious spices and fed upon tears of the resin.⁴ It may have been this that inspired the Egyptian queen Hatshepsut to mount an ambitious expedition to bring back incense trees from the land of Punt in 1490BC, to plant on the terraces of her mortuary temple at Thebes. Alternatively it may have been the claims of longevity, improved memory, or superlative anti-wrinkle treatment made from frankincense^{4,5,11} that attracted her, a pretty irresistible combination for most women, as well as pharmaceutical and cosmetic companies. Sadly the frankincense trees failed to flourish in the Egyptian climate.⁷ The Egyptians also used frankincense in ceremonial purification and in embalming, placing bags of it inside the body cavity.^{4,7}

In the Old Testament, God instructs Moses to blend frankincense and fragrant spices. Moses is to prepare the incense in the manner of a perfume-maker. The Greek word used is *myrrhos* but in early Bible translations, such as the King James version of 1611, the word is translated as "apothecary", making Moses, arguably, the first pharmacist in the Bible. The resulting incense was holy, to be burnt in the temple as an acknowledgement of God's presence.^{2,12}

Medicinally, frankincense was widely used to treat all manner of diseases, being mentioned in Greek and Roman pharmacopias, used by Muslim practitioners and

recorded in Chinese and Indian medical texts.⁴ Culpeper in his 'London dispensatory' (1656), recommended the resin to "heat and bind, fill up old ulcers and flesh and stop bleeding".¹³ Frankincense was powdered and used as talc, or in face creams. It was also added to wine, although drinking too much was said to cause madness or death. This property was employed in times of war when the resin was fed to war elephants to enrage them — literally incensing them.⁴

FRANKINCENSE TODAY

Frankincense is used today all over the world for its fumigant and medicinal properties as well as still playing a ceremonial role. In Arabia it is used for religious celebrations and traditional festivities, as well as to perfume hair, clothes and homes. In Yemen it is chewed by pregnant women, and used to treat emotional or psychological problems, as well as being burnt to ward off evil spirits. In Saudi Arabia the resin is used as a diuretic and as an aid to memory, being chewed or added to coffee.^{4,6}

In traditional Chinese medicine, frankincense is used to "invigorate the blood and



Frankincense oleo-gum-resin, produced by the Arabian Boswellia sacra

promote the circulation of Qi", reduce swelling and promote healing. Interestingly in oriental medicine it is contraindicated in pregnancy.¹⁴ Among the West Indian community in the UK frankincense is burnt to drive away spirits and also to treat coughs in children.¹⁵ In Ayurvedic medicine, the traditional medical system of India, frankincense derived from *B serrata* is used for cough, asthma, and a variety of inflammatory diseases such as rheumatoid arthritis, osteoarthritis and gout.¹⁶⁻¹⁸ One health food chain is in the process of marketing a standardised extract of *B serrata* in the UK.

The essential oil derived from frankincense is used in aromatherapy to treat depression and as an expectorant. It is also used for its soothing action in colds, bronchitis and laryngitis. It may be applied topically to reduce scarring,¹⁹ although there are reports of contact dermatitis occurring in sensitive individuals.^{20,21} On the internet all manner of formulations containing frankincense oil are available, ranging from the oil

and oleo-gum-resins to beauty products such as skin lotions and bubble bath. Alternative therapy creams and soaps containing frankincense oil are available for the treatment of eczema and psoriasis, although the manufacturer states that the oil is used for its "magical" qualities rather than its biological activity.²²

A recipe for a cream containing frankincense to expel wrinkles existed as early as the Ebers papyrus of 1500BC¹¹ and cosmetics company L'Oréal has recently launched an anti-wrinkle cream, containing boswellic acid complexed with manganese, which inhibited the contraction of dermal fibroblasts in tests (unpublished data). Frankincense continues to have a ceremonial role in the Christian church, the incense being burnt in Roman Catholic, Coptic and Orthodox churches.⁵

PHYTOCHEMISTRY

The phytochemistry of frankincense has been extensively researched. The oleo-gum-resin, contains 3 to 8 per cent oil, an ether soluble resin fraction of 60 to 70 per cent comprising sesquiterpenes, alcohols, esters and boswellic acids and an ether-insoluble gum fraction of 25 to 30 per cent, containing polysaccharides.^{23,24} Other non-volatile constituents include diterpenoids (composed of 20 carbon atoms).²⁵

The volatile oil contains numerous monoterpenes (C₁₀ compounds, in the form of hydrocarbons, alcohols and ketones) and sesquiterpenes (C₁₅ compounds) as well as diterpenes. Not unexpectedly, the composition of the oil differs according to the climate and harvest conditions as well as the geographical source.¹⁹

Numerous boswellic acids have been isolated from the oleo-gum-resin derived from Indian, Somalian and Arabian species of *Boswellia*.^{24,25} The acids are triterpenoids, (ie, C₃₀ compounds) formed as a pentacyclic ring system. They bear carboxyl, methyl, ketonyl and phenolic substituents and differ in the positions and numbers of unsaturated bonds. O-Acetyl derivatives also occur naturally in frankincense (often referred to in the literature simply as acetyl boswellic acids). For example, Indian frankincense from *B serrata* and the oleo-gum-resin from African *B sacra* have been shown to contain 10 boswellic acids and acetyl boswellic acids, the ratios of the compounds depending upon the species from which the resin was derived.²⁴ Boswellic acids have even been characterised from archaeological samples of frankincense dating back between 400 and 500AD.²⁶

PHARMACOLOGY

The pharmacological activities of frankincense, as crude extracts of the oleo-gum-resin, the purified essential oil and isolated compounds have been investigated. Frankincense oil exhibits antibacterial, antifungal and immunostimulant activity *in vitro* but lacks anxiolytic activity.^{19,27}

Of particular interest has been the pharmacological activity of frankincense derived from Indian *B serrata*, inspired by its Ayurvedic use in treating inflammatory diseases. Frankincense extracts were shown to exert anti-inflammatory and anti-arthritis activity *in vivo*. The active principles are boswellic acids. Their mechanism of action may be to block leukotriene biosynthesis (via inhibition of 5-lipoxygenase) combined with inhibition of human leukocyte elastase. These enzymes are thought to play a key role in a variety of inflammatory and hypersensitivity-based diseases.^{28,29} From clinical trials promising results have been claimed for patients with rheumatoid arthritis, chronic colitis, ulcerative colitis, Crohn's disease and bronchial asthma using frankincense extracts or solid dose formulations of *B serrata* oleo-gum-resin known as H15 and S compound.^{17,29,30} However the design of at least one study appears fundamentally flawed, making interpretation of the validity of the results difficult.

Another aspect of the pharmacological activity of extracts of *B serrata* that has recently come under intense scrutiny is their

potential antitumour activity, with cytotoxicity and apoptosis induction being demonstrated in a variety of *in vitro* models such as leukaemic and glioma cell lines.³¹ Boswellic acids are among the active constituents. They have been shown to inhibit 5-lipoxygenase, the first enzyme in the metabolic pathway leading to the formation of leukotrienes. Inhibition of this metabolism results in significant growth reduction and enhanced apoptosis in different cancer cell lines. The most potent inhibitor of 5-lipoxygenase of the triterpenoids so far tested is the naturally occurring acetyl-11-keto- β -boswellic acid (AKBA),^{28,31} which has demonstrated potent cytotoxic activity against meningioma cell cultures.³² Patients with malignant gliomas have been treated with the crude extract H15 with some apparent success, although this may be due to the reduction of peritumoral oedema rather than direct anti-tumour activity.¹⁷ Other acetyl boswellic acids have been shown to be more potent inhibitors of human topoisomerases I and II α than camptothecin, and amsacrine or etoposide, respectively.³³ Both these and AKBA merit

further investigation into their potential clinical applications.^{32,33}

CONCLUSIONS

Frankincense has been used for thousands of years by many different cultures. In ancient times its acquisition was hazardous and costly, and this was reflected in its great worth, and the way it was used. It was considered a fitting gift for emperors and kings⁴ and was also used for religious purposes. The magi certainly thought frankincense was an appropriate gift for the infant Jesus. Recent pharmacological studies have given a measure of credence to some of the traditional medicinal applications of the oleo-gum-resin, and have shown that ancient remedies may yet yield novel drugs. We would be wise men and women still to value frankincense.

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