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Frankincense tree facing uncertain future

By Mark Kinver and Victoria Gill Science reporters, BBC News and Nature

Boswellia are weakened if too much resin is drained from the trees' stems, leaving them vulnerable

Frankincense - a traditional staple of the Christmas story - faces an uncertain future, according to researchers.

Ecologists have warned that the production of the fragrant resin could decline by half over the next 15 years.

The festive fragrance is produced by tapping the gum of trees in the *Boswellia* genus.

The findings, based on a study carried out in Ethiopia, have been published in the Journal of Applied Ecology.

"There are several reasons why [the tree species *Boswellia* papyifera] it is under threat," explained co-author Frans Bongers, an ecologist at Wageningen University in the Netherlands.

"The forests that remain are declining because the old individuals are dying continuously, and there there no new individuals coming into the system. That means that the forests are running out of trees."

"In places like Oman and Yemen, it is being cut down systematically. Now, in Ethiopia, it is being cut down as land is being turned over to agriculture."

The small trees, which generally reach a height of no more than five metres (16ft), grows in

steep, rocky habitats, providing cover for other plant species.

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A sense of frankincense

- Frankincense is an oily gum resin from 16 different species of tree of the *Boswellia* genus
- Incense extracted from the resin is used in religious rituals, but has also been investigated for its medicinal properties. It is believed to be an anti-inflammatory
- The name frankincense is derived from the old French "franc encens", meaning pure incense

Each year, up to about 3kg of resin can be tapped from an individual tree. After about five years of tapping, management techniques suggest that the tree should be rested for a similar period in order to maximise future yields.

The genus *Boswellia*, overall, is generally classified as Vulnerable as a result of habitat fragmentation and poor levels of rejuvenation, explained Prof Bongers.

"If the tree germinates, then there is a small plant coming out of the ground, but then in the next dry season it goes down again because it is too dry," he told BBC News.

Rachel Webster Curator of botany, Manchester Museum

Frankincense is tapped extensively wherever the *Boswellia* trees grow. Its high value comes mainly from the fact that it is used extensively in religious rituals, particularly in the Islamic and Christian religions [and, historically, in Hebrew rituals].

The species focused on in this study, *Boswellia papyrifera*, grows in African drylands. It grows in arid areas so any small, deleterious change could have quite devastating effects on the regeneration of the trees.

In this case, it appears to be either fire or over-grazing, but with the general pressures of people and trees depending on the same land, trees tend to lose.

If these trees did disappear, it would be a great loss to the local people who tap the trees to sell the resin and to the ecosystem it grows in.

"Then in the wet season it comes up again. Yet in the next dry season it goes down again. That happens for a number of years, and we don't know how many years this happens - we know that it is at least six years.

"But it may be 10 years and we do not know what triggers what makes it come up above ground forever - maybe it is some sort of reserve, some sort of starch in the soil or root system.

"We are measuring this but we do not have real data, so it is complicated to manage the

seedlings."

Prof Bongers added that the encroachment of more opportunistic tree species was also affecting the long-term survival of the frankincense forests.

"In the landscape, these tree has been the dominant species. That is why we can call it a frankincense forest, just like we can refer to beech woodlands in the UK," he said.

"In these woodlands, 80% of the individuals are frankincense trees. Yet some areas at the verges of the distribution of the species, there are other species coming in.

"What we are seeing at the verges of the populations we are following is that that the frankincense trees are phasing out and other species are coming in.

"All the young individuals in the forests are from other species, such as *Acacia*. We just see the forests running out of frankincense - other species are taking over."

'Alarming' decline

The study examined 13 two-hectare plots, which involve monitoring more than 6,000 trees and collecting more than 20,000 measurements.

Using this data, the team modelled the fate of the species, and found the current levels of frankincense production is set to halve in the next 15 years.

"Current management of *Boswellia* populations is clearly unsustainable," Prof Bongers warned.

"Our models show that within 50 years, populations of *Boswellia* will be decimated, and the declining populations mean frankincense production is doomed. This is a rather alarming message for the incense industry and conservation organisations."

He added that tapping the trees for the valued resin was unlikely to be the main cause of the decline. Instead, there were a number of other things affecting the long-term future of the trees.

"Frankincense extraction is unlikely to be the main cause of population decline, which is likely to be caused by burning, grazing and attack by the long-horn beetle, which lays its eggs under the bark of the tree.

In the areas they studied, the team found that older trees in the population were not being replaced because few *Boswellia* seedlings survived to become saplings.

"The number of fires and intensity of grazing in our study area has increased over recent decades as a result of a large increase in the number of cattle, and this could be why seedlings fail to grow into saplings. At the same time, a large proportion of trees we studied died after being attacked by the long-horn beetle," Prof Bongers observed.

In order to ensure future rejuvenation, he suggested that areas should be set aside for up to a decade so young *Boswellia* trees can become established.

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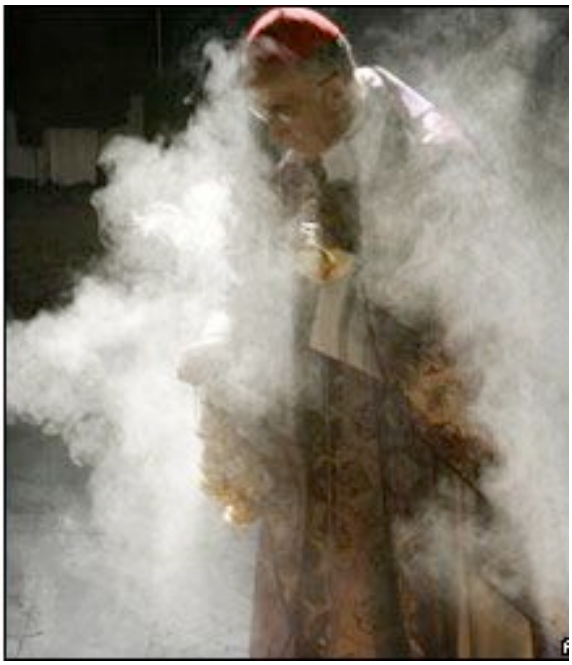
Frankincense: Could it be a cure for cancer?



The gift given by the wise men to the baby Jesus probably came across the deserts from Oman. The BBC's Jeremy Howell visits the country to ask whether a commodity that was once worth its weight in gold could be reborn as a treatment for cancer.

Oman's Land of Frankincense is an 11-hour drive southwards from the capital, Muscat.

Most of the journey is through Arabia's Empty Quarter - hundreds of kilometres of flat, dun-coloured desert. Just when you are starting to think this is the only scenery you will ever see again, the Dhofar mountains appear in the distance.

On the other side are green valleys, with cows grazing in them. The Dhofar region catches the tail-end of India's summer monsoons, and they make this the most verdant place on the

Arabian peninsula.

Warm winters and showery summers are the perfect conditions for the Boswellia sacra tree to produce the sap called frankincense. These trees grow wild in Dhofar. A tour guide, Mohammed Al-Shahri took me to Wadi Dawkah, a valley 20 km inland from the main city of Salalah, to see a forest of them.

"The records show that frankincense was produced here as far back as 7,000 BC," he says. He produces an army knife. He used to be a member of the Sultan's Special Forces. With a practised flick, he cuts a strip of bark from the trunk of one of the Boswellia sacra trees. Pinpricks of milky-white sap appear on the wood and, very slowly, start to ooze out.

Boswellia sacra produces the highest-quality frankincense

"This is the first cut. But you don't gather this sap," he says. "It releases whatever impurities are in the wood. The farmers return after two or three weeks and make a second, and a third, cut. Then the sap comes out yellow, or bright green, or brown or even black. They take this."

Shortly afterwards, a frankincense farmer arrives in a pick-up truck. He is white-bearded, wearing a brown thobe and the traditional Omani, paisley-patterned turban.

He is 67-year-old Salem Mohammed from the Gidad family. Most of the Boswellia sacra trees grow on public land, but custom dictates that each forest is given to one of the local families to farm, and Wadi Dawkah is his turf.

Camel train

He has an old, black, iron chisel with which he gouges out clumps of dried frankincense.

"We learnt about frankincense from our forefathers and they learnt it from theirs" he says. "The practice has been passed down through the generations. We exported the frankincense, and that's how the families in Dhofar made their livings."

Salem Mohammed: Young people prefer careers in oil or government

And what an export trade it was. Frankincense was sent by camel train to Egypt, and from there to Europe. It was shipped from the ancient port of Sumharan to Persia, India and China. Religions adopted frankincense as a burnt offering.

That is why, according to Matthew's Gospel in the Bible, the Wise Men brought it as a gift to the infant Jesus. Gold: for a king. Frankincense: for God. Myrrh: to embalm Jesus' body after death.

The Roman Empire coveted the frankincense trade. In the first century BCE, Augustus Caesar sent 10,000 troops to invade what the Romans called Arabia Felix to find the source of frankincense and to control its production. The legions, marching from Yemen, were driven back by the heat and the aridity of the desert. They never found their Eldorado.

Oman's frankincense trade went into decline three centuries ago, when Portugal fought Oman for dominance of the sea routes in the Indian and the Pacific Oceans.

Salalah's Haffa souk: The place to buy Omani brands such as Royal Hougari

Nowadays, hardly any Omani frankincense is exported. Partly, this is because bulk buyers, such as the Roman Catholic Church, buy cheaper Somalian varieties. Partly, it is because Omanis now produce so little.

"Years ago, 20 families farmed frankincense in this area," says Salem Mohammed Gidad.

"But the younger generation can get well-paid jobs in the government and the oil companies, with pensions. Now, only three people still produce frankincense around here. The trade is really, really tiny!"

Cancer hope

But immunologist Mahmoud Suhail is hoping to open a new chapter in the history of frankincense.

Scientists have observed that there is some agent within frankincense which stops cancer spreading, and which induces cancerous cells to close themselves down. He is trying to find out what this is.

The Catholic church mostly buys Somalian frankincense

"Cancer starts when the DNA code within the cell's nucleus becomes corrupted," he says. "It seems frankincense has a re-set function. It can tell the cell what the right DNA code should be.

"Frankincense separates the 'brain' of the cancerous cell - the nucleus - from the 'body' - the cytoplasm, and closes down the nucleus to stop it reproducing corrupted DNA codes."

Working with frankincense could revolutionise the treatment of cancer. Currently, with chemotherapy, doctors blast the area around a tumour to kill the cancer, but that also kills healthy cells, and weakens the patient. Treatment with frankincense could eradicate the cancerous cells alone and let the others live.

The task now is to isolate the agent within frankincense which, apparently, works this wonder. Some ingredients of frankincense are allergenic, so you cannot give a patient the whole thing.

FRANKINCENSE FACTS
Boswellia sacra grows in Oman, Yemen and Somalia
Other Boswellia species grow in Africa and India

The tree may have been named after John Boswell, the uncle of Samuel Johnson's biographer
In ancient Egypt frankincense was thought to be sweat of the gods
Source: The Pharmaceutical Journal

Dr Suhail (who is originally from Iraq) has teamed up with medical scientists from the University of Oklahoma for the task.

In his laboratory in Salalah, he extracts the essential oil from locally produced frankincense. Then, he separates the oil into its constituent agents, such as Boswellic acid.

"There are 17 active agents in frankincense essential oil," says Dr Suhail. "We are using a process of elimination. We have cancer sufferers - for example, a horse in South Africa - and we are giving them tiny doses of each agent until we find the one which works."

"Some scientists think Boswellic acid is the key ingredient. But I think this is wrong. Many other essential oils - like oil from sandalwood - contain Boswellic acid, but they don't have this effect on cancer cells. So we are starting afresh."

The trials will take months to conduct and whatever results come out of them will take longer still to be verified. But this is a blink of the eye in the history of frankincense.

Nine thousand years ago, Omanis gathered it and burnt it for its curative and cleansing properties. It could be a key to the medical science of tomorrow.

Jeremy Howell reports for Middle East Business Report *on BBC World News.*