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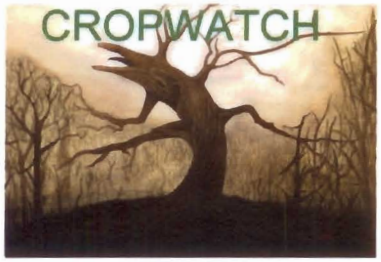

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E: info@cropwatch.org T: ++44 (0)7771 872 521

Sandalwood – A Critical View of Developments.

by Tony Burfield Feb 2009.

[Slightly modified from a feature first published on www.aromaconnection.org 15th Dec 2008 & as published in *Cropwatch Newsletter* Jan 2009].

Sandalwood Oil: Availability. The fact that some sandalwood species are under threat is an inconvenient truth ignored by many cosmetic companies & essential oil traders. Four *Santalum* (sandalwood) species are present in the IUCN Red List 2008, including the extinct *Santalum fernandezianum*. The more familiar *Santalum album* L. is one of the remaining three, being assessed as Vulnerable in 1998, but a more detailed breakdown of the eco-status of individual *Santalum* species from various geographical locations, with ancillary notes, is available on the Cropwatch's website, in the A-Z Section of the latest update of the Threatened Aromatics Plants data-base, at http://www.cropwatch.org/Threatened%20Aromatic%20Species%20v1.10.pdf. A comprehensive Sandalwood bibliography, together with many abstracts & (often critical) Cropwatch comments, is also available at http://www.cropwatch.org/SandalwoodbibVI.pdf. These two resources should help empower potential sandalwood oil buyers within the aroma industry to decide for themselves just how ethical their purchasing intentions might prove to be.

The shortage of sandalwood oil East Indian has been caused by the ravages of spike disease over many decades and to a lesser extent by fire, vandalism, animal damage & other factors, to the existing Indian sandalwood forests in Karnataka and Tamil Nadu, not to mention the ruthless over-exploitation of this declining resource by illegal distillers, smugglers and corrupt officials. Arguably the over-exploitation of sandalwood only came about because of the persistent market demand for sandalwood logs for incense, wood carving & furniture making, and the continued supply of sandalwood oil for sandalwood-based attars, and the other uses for sandalwood oil (which some have estimated at 250 tons/annum). Sandalwood sawdust from heartwood and roots, spent heartwood after distillation, sappy branches etc., mixed with potassium nitrate and gum Arabic has been traditionally used as a base for joss-stick production, and this practice has continued run on in spite of serious warnings regarding of

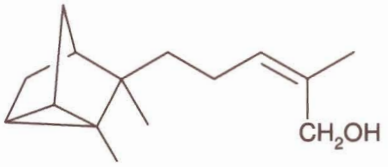
sandalwood's increasingly precarious ecological position within India.

A few years back, some aromatherapy profession officials and certain aromatherapy essential oil trading representatives belittled the threat to sandalwood (see Cropwatch bibliography), and inferred that if any blame was to be apportioned at all, it should be laid at the door of the major users, the fragrance industry. You will note that even now, within the EU, nationally-run aromatherapy vocational courses still obliviously feature sandalwood oil for study, in spite of representations from Cropwatch to the organisers. The incense trade, of course, have ignored their obligations almost completely, and as far as we can tell, many parts of the conventional perfumery trade have done the same.

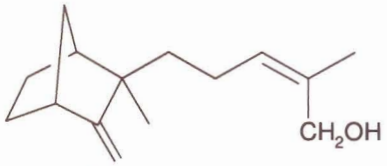
Sandalwood distillation has been carried out at Mysore, and to a lesser extent at Kuppam (Andhra Pradesh), Mettur, Bombay, Kanauj and Karkal (Ram 1997), however mobile stills have also been employed to evade forestry officials. The wood is usually reduced chips by electric chopper and thence to powder by grinders and soaked 48 hours prior to distillation, which is carried out for an extended period. Foreruns of the distillation constituting 2-5% of the total volume distilled (sandalwood terpenes) and are often rejected, as they may contain substitued pyrroles (especially N-furfuryl pyrrole), which detract from the overall odour. Reduction of the content of α- and β-santalenes and other more minor sesquiterpenes can also occur at this point, the solubility characteristics of the finished sandalwood oil in 70% ethanol (a standard test) being improved. High pressure stills are also used to distil the oil, which are loaded with up to a ton of wood. Distillation may be carried out for 2-3 days at under $3Kg/cm^2$, higher pressures often giving brashness. Decanted oil is re-steam distilled 2-3 days at $3Kg/cm^2$ and may then be further rectified. The yield of oil is sometimes conservatively stated at between 4-6.5%, but in practice 8% or even 12% can be obtained by high oil-yielding tree sections, reducing the roots to powder, etc. A proportion of the oil (some 15%) is left in the close grain structure of the wood. Further losses occur because of the water solubility of some of the components of the distillate. Extraction of the exhausted wood with aromatic solvents and then extraction of the solvent bearing the fragrant sandalwood oil with immiscible methanol transfers the odourous components to the methanol phase.

Sandalwood in Perfumery. It is only in recent centuries that sandalwood's sensual olfactory properties have been recognised in Europe, to an extent that, in recent times, in spite of its cost, it has become quite a common ingredient of perfumes and cosmetics. The quality of sandalwood oil has often been (over-simply) linked to its santalols content, where the standard of 90% santalols by wet chemical analysis (Guenther 1952 Vol 5, pp185-7) is often quoted. By high performance capillary gas chromatography, a different story unfolds, and Verghese *et al.* (1990) established that for sandalwood oil E.I., the normal range is α-santalol: 40-45% and β-santalol: 17-27% (through Lawrence 1991), although other sesquiterpene alcohols such as *epi*-β-santalol, (*E*)-β-santalol, spiro-santalol. *cis*-nuciferol also occur. It is known however that (+)-(*Z*)-α-santalol has only a weak odour, and that (-)-(*Z*)-β-santalol contributes more significantly to the

odour profile, although some 40% of people are believed to be anosmic to the urinic aspects of this compound. Also important are the oxidative degradation products of these alcohols such as (+)-(*E*)-α-santalal. A more detailed examination of the odour profile of sandalwood oil is found in a review by Anonis (1998).



alpha-santalol



beta-santalol

Amongst the many useful applications of sandalwood oil East Indian in the perfumery art, we can say it is invaluable in the formation of long-lasting radiant sensual oriental accords, particularly when blended with jasmin and musks. It is frequently deployed as part of indulgent woody blends in masculine perfumery, and is useful in lending a radiant depth to floral extrait compositions. It blends superbly well with ionones, iris and jasmine.

Alexandre Choueiri (2008), head of Lancome UK, speaking at the *Sandalwood Conference 2008, Kununurra, W. Australia*, noted that of 7,000 classified fragrances since the year 1750, 3212 contain sandalwood notes. Drawing on data from *Fragrances of the World* by Michael Edwards, Choueiri makes the point that of (only) 106 current fragrances now listing Sandalwood, only 36 detail Indian sandalwood, and of those, only 16 detail Mysore sandalwood. Of the 36 fragrances marketed by leading fragrance houses, subject to correction, I counted 2 supplied by Robertet, 9 by IFF, 4 by Drom, 2 by Takasago & 3 by Firmenich Of these 16 current fragrances allegedly employing Mysore sandalwood, 4 are supplied by IFF, 2 by Givaudin (Quest), 1 by Firmenich, and 1 by Symrise. So what are we to gather from this? That the use of sandalwood oil in fragrances is in decline, but that major aroma corporates are still ruthlessly exploiting what remains of the world's sandalwood reserves? If they are, they are not alone in doing this. Another speaker at the conference, Venkatesha Gowda, who works for the R&D Dept. of Karnataka Soaps & Detergents Ltd., a long-time manufacturer of sandalwood soap, maintains that in spite of the official figures (14 tons/annum of sandalwood oil exported from Tamil Nadu during 2007-8), the current (2008) annual production of sandalwood is actually 3,000 - 4,000 tons and for sandalwood oil it stands at 120-150 tons, of which 80 tons/annum of sandalwood oil is consumed by the domestic market. Gowda also remarks that sandalwood oil is adulterated by polyethylene glycols, African sandalwood oil (*Osyris lanceolata*), castor oil and coconut oil, and that he has been involved in planting *O. lanceolata* trees in India (but hopefully not with trees smuggled out of Tanzania!). Whilst not condoning the trade in sandalwood oil at all, it seems strange to Cropwatch that more prospective buyers do not carry out a simple solubility test with 70% ethanol at 20° C (if you are unaware of the details of such a test, contact Cropwatch), which is often a good indicator of the presence of

added adulterants, such as vegetable oils. OK, its not rocket science, but sometimes it's a useful test.

Also of interest, is the fact that the Lush company publicly own up to using 1 ton per annum of New Caledonian sandalwood oil (see http://www.lush.co.uk/Shop/FeatureDetail.aspx?fdShopFeatureId=6888) and have forwardly contracted to buy TFS Australian sandalwood (Bird 2008), as confirmed by Mark Lincoln of Lush Australasia, speaking at the *Kununurra Conference*. Cropwatch has reservations about the ecological effects from the abstraction of such large volumes of sandalwood oil from New Caledonia (bearing in mind that Lush are not the only buyers of the oil from this limited source); & none of the information presented on Cropwatch's various data-bases supports this rate of extraction (see for yourselves!). We remain open to persuasion that this policy can be truly sustainable, according to our strict interpretation of the word, but would only be too happy to review and post up any forwarded evidence to the contrary.

Australian Ambition. Of course it is well publicised that Australia has ambitions to become a major supplier of oil from *Santalum album* in the future (see the multitude of articles on this subject listed in the Cropwatch sandalwood bibliography, mentioned above), and the *Kununurra Sandalwood Conference 2008* can primarily be seen as a conference designed by TFS mainly to re-assure investors in Australian sandalwood plantations. Indeed, the trade magazine *Perfumer & Flavorist*, once the flagship magazine for the industry, apparently reproduced the conference organiser's promotional material *per se* without critical comment - to us, another sign of the slipping standards of this once-great magazine. Overall, Cropwatch remains skeptical of the ability of the Australian sandalwood machine to supply sandalwood oils in the volumes estimated, of being an acceptable odour quality, & at a price that the market is prepared to pay, bearing in mind the current economic climate, the downward pressure on aroma ingredient prices, and the easy availability of very cheap synthetic sandalwood aroma chemicals.

Cropwatch is persuaded that with proper policies & investments, some sandalwood sources can be made truly sustainable, and we believe this may well the case in Vanuatu. However, taking pure sandalwood oil East Indian as a benchmark, the odour profiles of sandalwood oils from other geographical locations and/or other species are usually different in character, lack fine notes, and may be over-sweet (as with East African sandalwood oil) or predominantly woody-camphoraceous (as with Chinese sandalwood oil), or just plain lacking in impact & character (as with Indonesian sandalwood oil). From here, the future looks difficult for sandalwood.

(All references can be located in the Sandalwood bibliography mentioned above, which is continuously revised and updated).