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Little Things Matter: Effect of Minor Constituents on Aroma Profile of Indian Sandalwood Oil

Little Things Matter: Effect of Minor Constituents on Aroma Profile of Indian Sandalwood Oil
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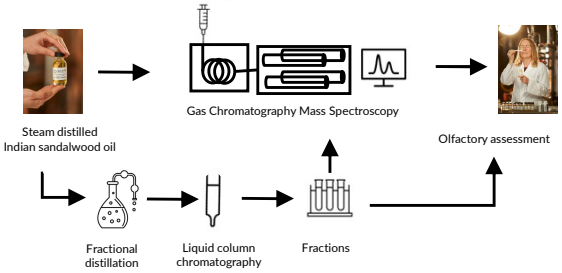
Introduction:

- Indian sandalwood oil is essential oil distilled from the heartwood of *Santalum album* plant
- It is among the earliest recorded perfumery ingredients for humankind
- Essential oil of Indian sandalwood as first recorded to distilled around the 10th century in India
- Indian sandalwood oil is an essential base note in perfumery as well as a aroma fixative in traditional oriental and modern western perfume styles
- Sandalwood belongs woody amber (oriental) olfactory family
- There are over 125 reoccurring constituents in Indian sandalwood oil
- Unique aroma of sandalwood among them two sesquiterpene alcohols, alpha and beta santalols
- Quality parameters of Indian sandalwood oil is given on ISO 3518 standard and the British Pharmacopoeia
- Sandalwood oil has a green diffusive top notes a sweet and animalic heart notes followed by a tenacious creamy, woody and a sweet aroma.
- Total olfactory profile of sandalwood depends upon number of minor constituents which produce a balanced and natural aroma
- Indian sandalwood oil was primarily produced from matured wild stands found in southern India, Sri Lanka, Indonesia and East Timor
- IUCN has classed Indian sandalwood as a vulnerable species in the red list of conservation
- Sustainable plantations are producing Indian sandalwood oil in Australia with younger trees
- Aroma profile of plantation grown Indian sandalwood to be understood from a olfactory and chemical perspective
- Indian sandalwood oil samples sourced from plantations were subjected to identifying different classes of chemicals.
- Understanding the chemistry and olfactory role of minor constituents help the sustainable plantation industry to cater the perfume with subtle nuances which are produced only by natural Indian sandalwood.

- From establishment of plantations, forest management, harvest, wood processing, distillation and blending plays a role in chemical and aroma profile of Indian sandalwood.

Materials & Methods:

- Indian sandalwood oil was obtained from plantation S. album trees of 15 -20 years old cultivated in Kununurra, Western Australia
- Oil was distilled by batch steam distillation and complied with ISO 3518:2002 for physiochemical parameters and GC profile
- Qualified perfumers and a trained panel identified the olfactory profile of Indian sandalwood oil
- Mass fraction data were obtained for identified peaks on chromatogram (30x0.25x0.25 polar column)



- Pure essential oil was fractional distilled under different vacuum conditions. Fractions were further separated by liquid column chromatography with normal phase silica and solvent gradient with increasing polarity
- Fractions obtained by distillation and chromatography were further analysed by GCMS
- Fractions were assessed for olfactory properties by the olfactory panel and recorded the noted

Results & Discussion:

Table 1: Major chemical classes, composition, constituents and odour profile of Indian sandalwood oil

Chemical Class	Key Constituents	Odour Profile
Santalols 80%	cis-α-santalol 41-50%; cis-β-santalol 20-24% z-α-trans bergamatol, cis-β-santalol	soft woody, nutty, milky, musky, warm, cedarwood intense warm woody, milky, animalic, typical sandalwood woody, citrus
Terpenes 6 %	α-santalene, β-santalene, α-bergamatene, curcumene and α-bisobalene	similar to α-santalol which is soft woody, nutty, milky, musky, warm, cedarwood
Aldehyde and ketones 4%	α-trans-bergamotenone, α and β santalals	Intense milky, nutty, fatty tonalities, much desired for Indian sandalwood oil.
Carboxylic acid (product of fungal attack) <1%	nor-tricyclo-eka-santalic acid and *epi*-β-nor bicyclo-eka-santalic acid	animalic and musky odour of Indian sandalwood, excessive amounts give a repulsive "smelly sock" odour
Other Sesquiterpenes <5%	bisabalol, curcumen-12-ol, lanceol and nuciferol, farnesol	low odour contribution which can be easily masked by the major constituents and other minor constituents
Phenolics (wood break down) <0.05%	vanillin eugenol and allyl syringol	Sweet, medicinal, smoke
Furan derivatives (Millard type) <0.1%	5-methyl furfural and furfural pyrrole	caramel, gourmand and smoke

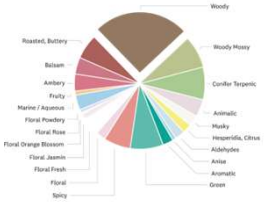


Figure 1: Complete olfactory profile of Indian sandalwood oil

Conclusions:

- Indian sandalwood oil exerts its complex aroma profile due to number of minor constituents
- Synthetic or biosynthetic sandalwood analogues mimic only the odour profile of santalols, thus a balance profile of natural essential oil is lost

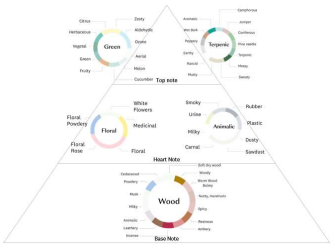


Figure 2: Olfactory description of top, heart, and base note of Indian sandalwood oil

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