

# Essential oil content and composition of Indian sandalwood (*Santalum album*) in Sri Lanka

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**Abstract:** *Santalum album* (Indian Sandalwood) is found in the mountainous regions of the intermediate zone of Sri Lanka. Few studies have been conducted on sandalwood ecology in this region, and ours is the first recorded study of essential oil content and chemical composition of heartwood. We harvested two trees with State permission and took cross-sections for analysis. We demonstrated a difference in the heartwood formation and oil yield of the trees. The composition of the oil was found to be consistent between trees and along the trunk of the tree. Main aromatic compounds were santalols and other compounds are recorded in lesser quantities. Results of this study comply with the other published work on sandalwood elsewhere. This initial study on *S. album* in Sri Lanka provided promising results for the future of sandalwood agroforestry.

**Key words:** essential oil; Sri Lanka; Sandalwood; *Santalum album*; santalol

## Introduction

Indian Sandalwood (*Santalum album* L.) is found in the tropical mountainous regions of Southern India, Sri Lanka and several islands of the Indonesian archipelago. Sandalwood has many uses in modern and traditional markets. Essential oil distilled from the wood is highly valued in the perfume industry for both its aroma and fixative properties. Traditional markets require

carving logs and also powders to prepare incense known as agarbatti (Fox 2000). Although naturally grown *S. album* has been recorded in Sri Lanka, a sandalwood industry has never developed here (Tennakoon et al. 2000). Sandalwood has been harvested from the wild over generations for traditional Ayurvedic medicines used to treat skin conditions and in paediatric formulations (Department of Ayurveda 1980)

The value of a sandalwood tree depends on three important characters (i) the volume of heartwood; (ii) the concentration and (iii) quality of its heartwood oil (Doran et al. 2005; Brand et al. 2007). The quality of sandalwood oil depends primarily on the concentration of two major sesquiterpene alcohols (*cis*- $\alpha$ -santalol and *cis*- $\beta$ -santalol), which produce the pleasant characteristic aroma. According to many standard documents (ISO 3518:2002; Howes et al. 2004), the combination of these two compounds (known as total santalol content) accounts for 90% of the total volatile material from the wood. *S. album* heartwood is known to have the highest concentration of oil and the highest proportion of santalols (Verghese et al. 1990; Baldovini et al. 2011). Sandalwood oil content increases with the age of the tree as more heartwood is formed over the time. Biosynthesis of the sandalwood sesquiterpenes depends upon a group of enzymes known as sesquiterpene synthase, which are specific for each type of sesquiterpene. Although the enzymes are regulated genetically, biosynthesis of sesquiterpenes might also be affected by other environmental factors (Jones et al. 2008; Jones et al. 2011).

Global sandalwood resources are diminishing and the demand is increasing (Gillieson et al. 2008). *S. album* populations in Sri Lanka are rapidly decreasing due to habitat destruction, over exploitation and complex silviculture associated with the root hemi-parasitic nature of sandalwood (Tennakoon et al. 2000). For this reason *S. album* was listed as a protected plant (Flora and Fauna Protection Ordinance Act 2009) and its harvest and transport are strictly prohibited in Sri Lanka.

Government of Sri Lanka invited the private sector to invest in forest plantation establishment and management with the intention of increasing national tree cover (Forest Sector Master Plan 1995). Since 2000, a few private sector companies have started forest plantation establishment using broad-leaf mahog-

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