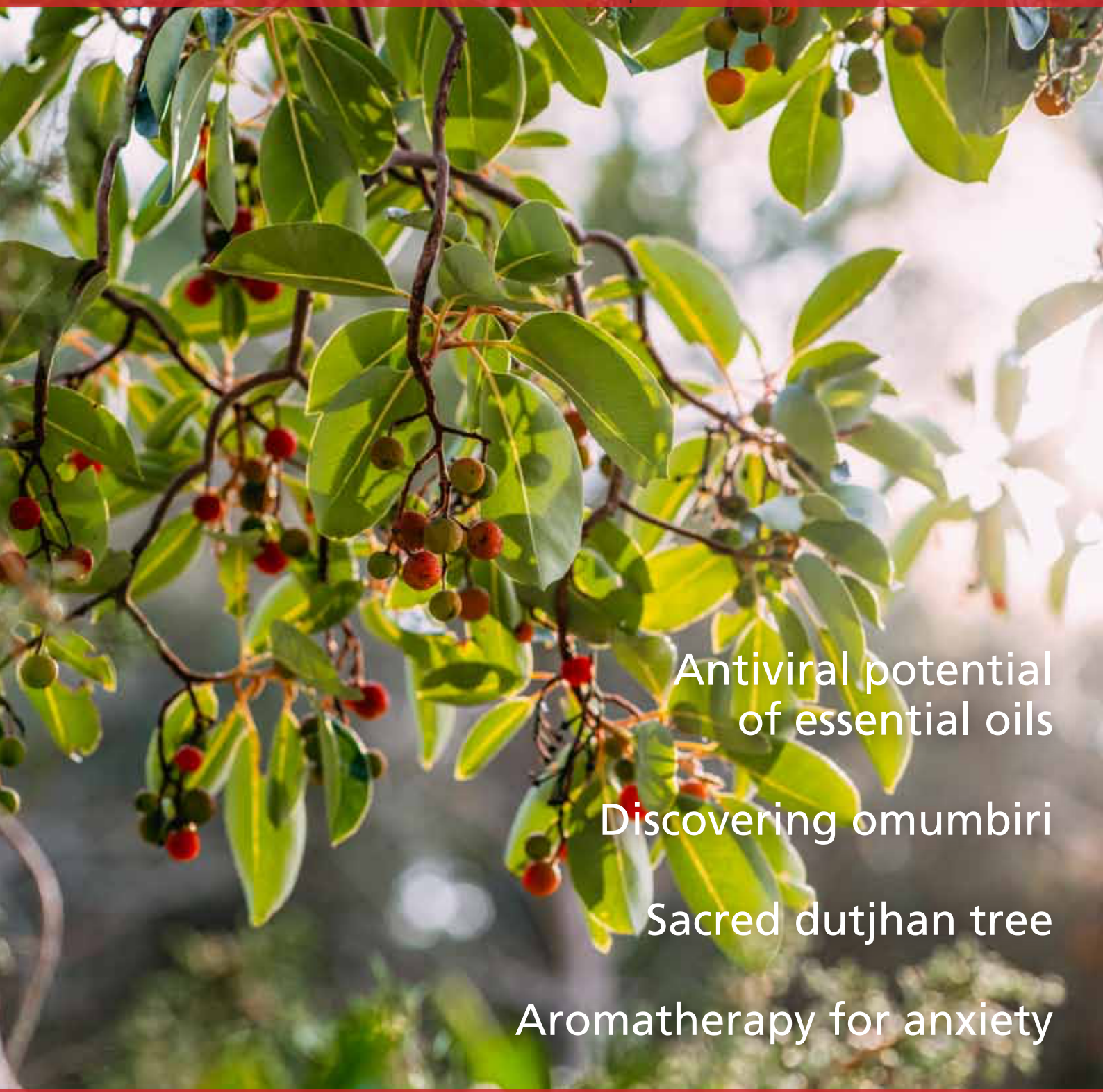
In Essence

Journal of the International Federation of Professional Aromatherapists



Antiviral potential of essential oils

Discovering omumbiri

Sacred dutjhan tree

Aromatherapy for anxiety

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Pat Herbert

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Guidance for authors

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Editor's letter

Autumn/Winter 2022

Welcome to this second 2022 edition of *In Essence* in which there's a strong international flavour. We have contributions focusing on essential oils, medicinal plants and aromatherapy in several countries around the world.

We open with the first of two articles by Dr Kelly Ablard and Jennifer Peace-Rhind on Omumbiri, a rare Namibian resin and essential oil. This first part (page 9) focuses on the plant's taxonomy, biology, importance and sustainability, while the second part will provide Omumbiri essential oil profiles and explore the oil's energetics.

We stay in Africa for Raghda Abdelmaksoud's guided tour of Egypt, ancient and modern, in which she evokes the country's vibrant colours and fragrances, and explores its traditional use of herbs and medicinal plants (page 50).

Our next stop is Australia where Gabriel Mojay, in the first part of a two-part article, reports on the Western Australian sandalwood tree and its essential oil (page 30). Western Australian sandalwood (*S. spicatum*), known as *dutjahn* by the Indigenous Martu people, is one of six Santalum species endemic to the Australian Continent.

Few places around the world escaped the impact of COVID-19 and scientists worked at great speed to devise vaccines and treatments. On page 14 Jenny Ditch evaluates early research studies suggesting that essential oils may have a potential role to play in the ongoing fight against this and other viruses.

Three articles focus on essential oils to help improve quality of life and well-being: Helena Chi reports on working with a client with low mood and anxiety (page 27), Sara Enock shares her experience of helping a client with chronic fatigue (page 47), and Priya Ganatra and Nick Singer highlight their project to relieve the distress of parents of very sick children (page 39).

On page 20 midwife aromatherapists Lucille Casey and Sam Todd begin a four-part series on common medical disorders during pregnancy and how essential oils can help. Their first article highlights gastrointestinal concerns.

In our My Practice feature (page 36) we talk to aromatherapist and teacher Victoria Plum about her philosophy of practice and her multi-therapy approach. And, on the eve of his retirement, we interview ATC Administrator Ray Gransby about his work with the aromatherapy profession over many years (page 54).

Elsewhere, Ian Cambray-Smith looks at citrus oils (page 13), Michele Riveroll profiles Tulsi (page 44), Ray Gransby reflects on aromatherapists' changing concerns (page 25), Anita James reports on Botanica2022 (page 57), and we have contributions from international IFPA members on pages 18 and 59.

Pat Herbert

Pat Herbert *Editor*

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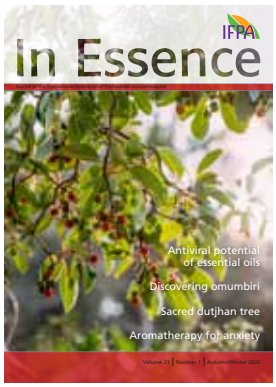

Photo: Berries on Sandalwood branches
Credit: AegeanBlue – iStock

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Regular features

The sacred dutjahn tree

In a two-part article **Gabriel Mojay** explores the Western Australian sandalwood tree and its essential oil: a sustainable source of an ancient aromatic medicine

Introduction

The Santalaceae family consists of 29 genera composed of approximately 400 species, 19 of which belong to the Santalum genus (Harbaugh *et al*, 2010). Indian sandalwood (*Santalum album*) has long held a prominent position culturally and economically in India and throughout the world, while Western Australian sandalwood (*Santalum spicatum*) has been an important timber crop since the 1850s, valued for its fragrant heartwood, essential oil and nut oil (see Figure 1).

Western Australian sandalwood (*S. spicatum*), known as *dutjahn* by the indigenous Martu, the tree's ancestral guardians, is one of six Santalum species endemic to the Australian Continent. *S. spicatum* is concentrated in the arid and semi-arid areas of western and southern Australia (Harbaugh, 2007).

Sandalwood is a root hemiparasite that draws water and nutrients from host trees through *haustoria* – root-like structures that grow into or around another plant structure in order to absorb moisture and nourishment. Capable of photosynthesis, hemiparasitic plants do not necessarily have a negative influence on their host (Loveys & Tyerman, 2002).

Hemiparasites such as Santalum produce large, nutritious fruits which help to sustain other species; thus, the tree functions ecologically to redirect nutrients from the host important to the survival of other organisms (Watson, 2009; Watson *et al*, 2011).

Due to their hemiparasitic nature, sandalwood trees are found in habitats suited primarily to their hosts, from fertile meadows to granite cliffs. Acacia trees are the most common hosts, though species of Eucalyptus, Casuarina and other shrubs are also seen.

Conservation and composition

Australia is home to six species of Santalum, which ranges as a genus from India and Papua New Guinea to the Pacific Islands (Harbaugh & Baldwin, 2007). The six species occurring in Australia - *Santalum spicatum*, *S. lanceolatum*, *S. leptocladum*, *S. acuminatum*, *S. murrayanum*, and *S. obtusifolium* - are distributed widely across the Continent.

Species of the genus Santalum have been heavily exploited for many centuries, to the extent that the 19 species listed in Table 1 (see opposite) are now classified globally or nationally as:

- Vulnerable (six species incl. *S. album* and *S. spicatum*)
- Near Threatened (one species: *S. austrocaledonicum*)
- Endangered or Imperilled (10 species)
- Critically Endangered (one species: *S. macgregorii*)
- Extinct (one species: *S. fernandezianum*)

The long-standing commercial exploitation of the oil-rich fragrant heartwood has resulted in a deep reduction in the biodiversity of the genus as a whole. Together with the effects of climate change on natural resources, the situation is one that requires - indeed *has* required - effective action to preserve what is left of remnant native and wild species.

FAMILY	Santalaceae
BINOMIAL	***Santalum spicatum***
SYNONYMS	*Santalum cygnorum* *Santalum diversifolium* *Eucarya spicata* *Fusanus cignorum; F. spicatus* *Fusanus spicatus var. frutescens* *Mida cignorum; M. spicata* Dutjahn (Martu) Waang (Noongar)

Figure 1: S. spicatum *has a sweet-woody fragrance*

TABLE 1: SANTALUM SPECIES

SPECIES	HABIT	ORIGIN	CHEMISTRY	IUCN STATUS
Santalum spicatum West Australian sandalwood *dutjahn* (Martu); *waang* (Noongar)	shrub	southwest Australia	(Z)-α-santalol (25-40%), (Z)-β-santalol (8-15%)	Vulnerable
Santalum album Indian sandalwood *chandana* (Sanskrit); *chandan* (Sanskrit)	tree	India, Sri Lanka, eastern Indonesia, northern Australia	(Z)-α-santalol (42–54%), (Z)-β-santalol (18–28%)	Vulnerable
Santalum acuminatum desert quandong; sweet quandong *guwandhang* (Wiradjuri); *wolgol* (Noongar)	shrub	central & southern Australia	No santalols. Santalbic (ximenynic) acid in seed oil (32-46% of total fatty acids).	Vulnerable (TPWC Act)
Santalum austrocaledonicum Coral Sea sandalwood *sandalwud* (Vanuatu); *bois de santal* (French)	tree	New Caledonia & Vanuatu	(Z)-α-santalol (46-50%), (Z)-β-santalol (18-25%)	Near Threatened
Santalum boninense Bonin Islands sandalwood *muninbakudan* (Japanese)	shrub	Ogasawara-shoto, Japan	[not extracted]	Endangered: Japan
Santalum ellipticum coastal sandalwood *ʻiliahialoʻe* (Hawaiian)	tree	Hawaiian Islands	[not extracted]	Imperilled (NatureServe)
Santalum fernandezianum Chile sandalwood *sándalo de Juan Fernandez* (Spanish)	tree	Juan Fernández Islands, Chile	[not extracted]	Extinct
Santalum freycinetianum forest sandalwood, Freycinet sandalwood *iliahi* (Hawaiian)	tree	Hawaiian Islands	[not extracted]	Endangered
Santalum haleakalae Haleakala sandalwood *ʻiliahi* (Hawaiian)	tree	East Maui volcano Maui, Hawaii (slopes of Haleakalā)	[not extracted]	Vulnerable
Santalum insulare Polynesian sandalwood *puahi* (Marquesas Islands, French Polynesia)	tree	eastern Polynesia	[not extracted]	Endangered
Santalum involutum Involute sandalwood *ʻiliahi* (Hawaiian)	tree	Hawaiian Islands (Kaua'i)	[not extracted]	Endangered
Santalum lanceolatum desert quandong, northern sandalwood bale bush, *dumbuyumbu* (Marra; Alawa)	shrub	eastern & northern Australia	(Z)-α-santalol (0.6-2.6%), (Z)-β-santalol (2-4.3%), Z-lanceol (20–90%)	Endangered: Australia
Santalum macgregorii Papua New Guinea sandalwood *botto* (Motu)	tree	Papua New Guinea	(Z)-α-santalol (0.5-51%), (Z)-β-santalol (>24%), (Z)-lanceol (0–72%)	Critically Endangered
Santalum murrayanum bitter quandong *coolyar* (Noongar)	tree	southern Western Australia	[not extracted]	Endangered: Australia
Santalum obtusifolium blunt sandalwood southern sandalwood; scrub sandalwood	shrub	eastern Australia	ximenynic acid (72%) & oleic acid (14%) in fruit kernels	Vulnerable: Australia
Santalum paniculatum mountain sandalwood, Hawaiian sandalwood, *ʻiliahi* (Hawaiian)	tree	Hawaiian Islands	(Z)-α-santalol (35-40%), (Z)-β-santalol (11-16%)	Vulnerable
Santalum papuanum ba bu ya tan xiang (Chinese)	tree	New Guinea	[not extracted]	[not listed]
Santalum pyrularium Kauaʻi forest sandalwood	tree	Kauaʻi, Hawaiian Islands	[not extracted]	Endangered
Santalum yasi yasi; yasi dina (Fijian)	tree	Fiji, Tonga, Niue	[not extracted]	Endangered

Today, much of the world's demand for sandalwood essential oil is met by West Australian sandalwood (*Santalum spicatum*), due to the similarity of chemical composition and fragrance it shares with *S. album* (Pullaiah & Swamy, 2021).

To reduce pressure on wild stands, Western Australian sandalwood is often harvested from stands on plantations established on former agricultural land. The potential exists for the significant improvement of *S. spicatum* plantations through the selection of trees with desirable growth characteristics and chemical constituent profiles. The sustainable development of this species - a species adapted to the arid biosphere of Western Australia - will advance conservation goals as well as improve the essential oil's commercial potential (Moniodis *et al*, 2017).

Sandalwood essential oil is commonly produced through the steam distillation of the chipped heartwood, over 40-70 hours. Oils are also produced through hydrodistillation, steam-hydrodistillation, microwave hydrodistillation and supercritical carbon dioxide (CO2) extraction. The oil is generally colourless to pale-yellow, and slightly viscous (Kusuma & Mahfud, 2016).

The essential oil of *Santalum album* develops in the heartwood and root of the tree over a 10-15 year period. Trees require 60-80 years to produce essential oil considered by those in the industry to possess the finest aroma. The average yield by weight of *S. album* oil is 4.5-6.25 per cent, with the greatest concentration occurring in the roots, at proportions of up to 10 per cent by weight (Baldovini, 2011). Similarly, essential oil is produced in the heartwood of *S. spicatum* trees 10 years old and older.

Sandalwood extracts consist of a complex mixture of sesquiterpenoids with a distinct chemical make-up apparent across species, and frequently observable within species (Moretta, 2001). More than 230 constituents belonging to different chemical classes have been identified in the heartwood of *S. album*. While these are mainly terpenoids, the tree is also rich in saponins, phenolics and tannins (Misra & Day, 2012).

Of the many chemical constituents that have been identified in *S. album* essential oil, the sesquiterpenic geometric isomers α-santalol and β-santalol (C15H24O) are the most abundant (see Figures 2 & 3 below) (see Tables 2 & 3 opposite). α-santalol and β-santalol consist of a bicyclic ring system covalently linked to an aliphatic unsaturated chain containing a hydroxyl functional group. They are the principal molecules responsible for sandalwood oil's fragrance as well as its biological activities.

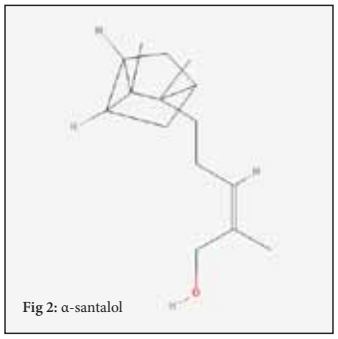


Fig 2: α-santalol

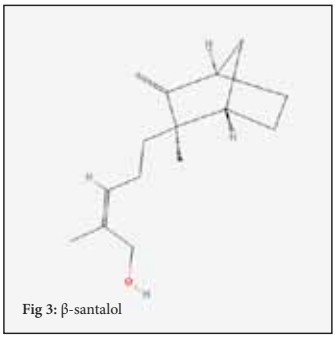


Fig 3: β-santalol

α-santalol is a sesquiterpenic alcohol with a molecular weight of 220.35g, a boiling point of 166° C, and density of 0.9770 g/cm3. α-santalene, α-santalal, β-santalal, epi-β-santalal, α-santalol, β-santalol, (E)-β-santalol, α-bergamotol and spirosantalol have been identified as key odour components in sandalwood oils (Nikiforov *et al*, 1988; Howes *et al*, 2004).

α-santalol contributes a mild sweet-woody scent, while β-santalol is more responsible for the oil's characteristic, widely-admired smooth, creamy, sweet-woody, musky-diffusive fragrance (Baldovini *et al*, 2011). In terms of established international essential oil trade standards, *S. album* should contain between 41-55 per cent α-santalol and 16-24 per cent β-santalol (Dwivedi *et al*, 2003).

The heartwood of *S. spicatum* contains over 100 individual sesquiterpenes. These compounds have demonstrated a fungicidal action consistent with the theory that sesquiterpenes protect against wood-rotting fungal pathogens due to their high concentration in the inner heartwood.

The most abundant compounds in *S. spicatum* essential oil are α- and β-santalol, farnesol, nuciferol, α- and β-bisabolol, bergamotol and lanceol, together with a variety of minor compounds including olefins such as the santalenes, bergamotene and curcumenes (Brophy *et al*, 1991; Valder *et al*, 2003).

A study of the heartwood cores of 87 *Santalum spicatum* trees from 12 different sites in Western Australia revealed that levels of α- and β-santalol can vary from 3-67 per cent, and E,E-farnesol from 5-30 per cent across the entire distribution range (Moretta, 2001).

Western Australian sandalwood nut oil is produced through cold expression of the kernel to produce an oil rich in the monounsaturated omega-9 oleic acid, and the polyunsaturated acetylenic fatty acid ximenynic acid. Ximenynic acid has demonstrated anti-inflammatory, antiproliferative, proapoptotic, and anticancer activities (Cai *et al*, 2016) as well as an antidiabetic effect (Zhang *et al*, 2021) (See Table 4 opposite)

Traditional and scientific therapeutics

Sandalwood essential oil possesses a milky-musky, sweet-woody fragrance consistent in psycho-energetic terms with its ability to calm the mind and soothe, centre and uplift the spirit.

Warmly aromatic yet soft and 'neutral', its unimposing fragrance nature has contributed to its status as a classic perfume fixative. It is this same unique quality that makes sandalwood essential oil intrinsic to the production of traditional aromatic oils in Kannauj, India, in which it provides flowers such as champaka and jasmine with a luxuriously diffusive solvent base to produce the floral *attar* (from the Arabic for 'perfume, essence').

For centuries in the Indian subcontinent, the benefits of sandalwood's uniquely potent phytochemistry have been exploited in the form of pastes, emulsions, decoctions and powders as well as through the essential oil and traditional attar. From an Ayurvedic perspective, sandalwood was considered *Sattvic* - corporeally and spiritually pure; beneficial for both mind and body,

TABLE 2: INDIAN SANDALWOOD (*SANTALUM ALBUM*) ESSENTIAL OIL KEY CONSTITUENTS

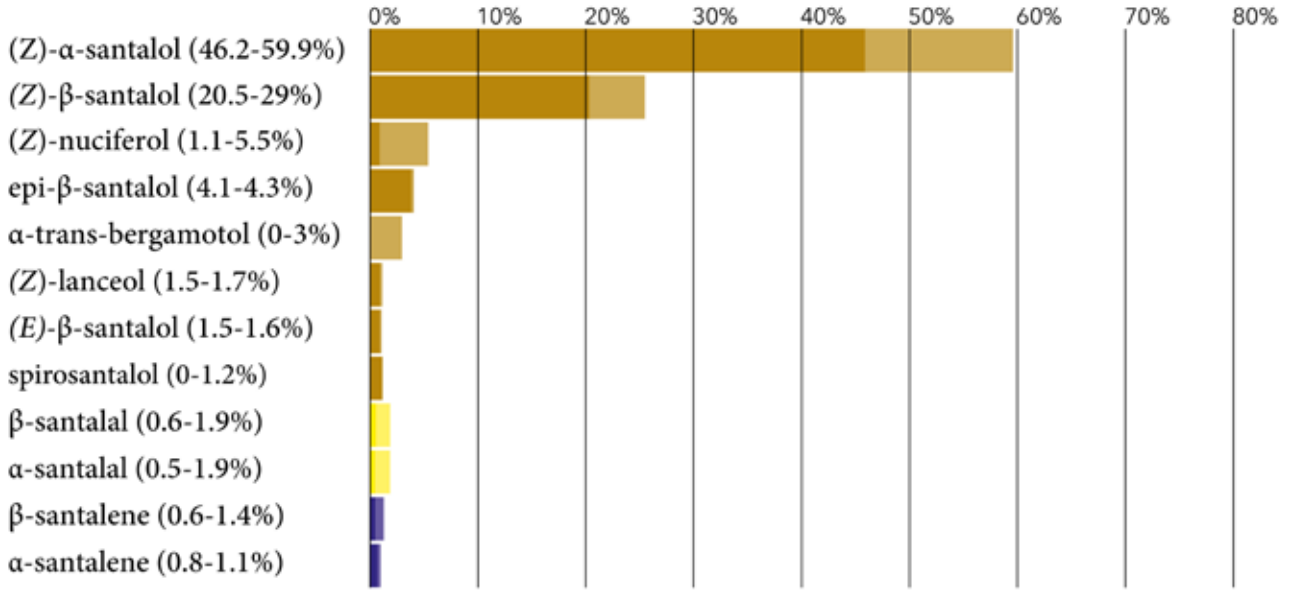


TABLE 3: WESTERN AUSTRALIAN SANDALWOOD (*SANTALUM SPICATUM*) ESSENTIAL OIL KEY CONSTITUENTS

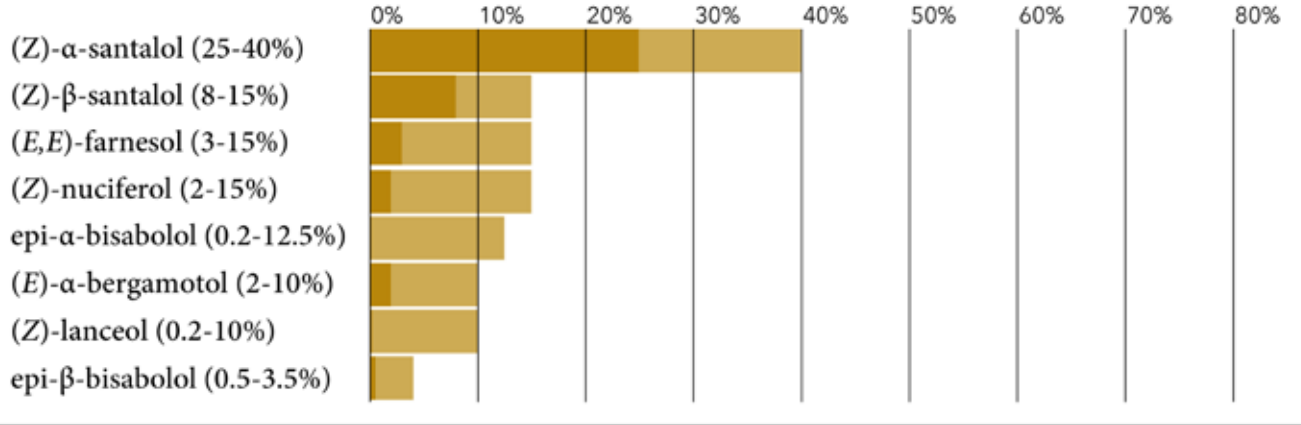
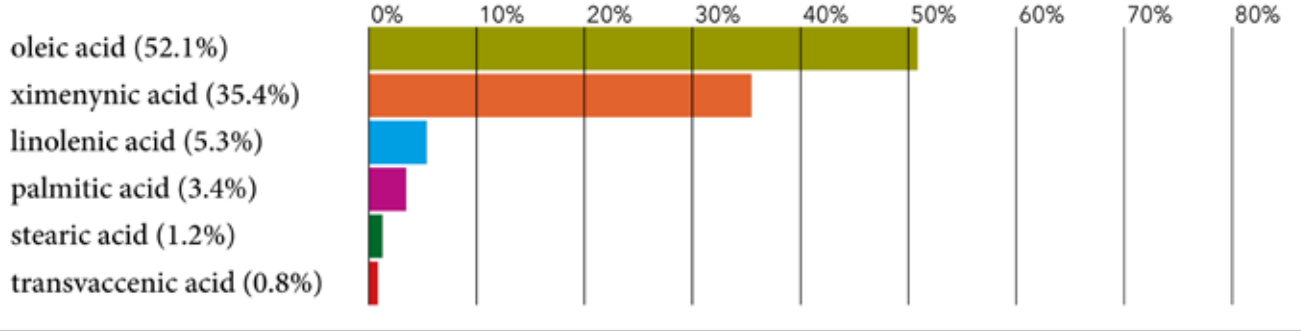


TABLE 4: WESTERN AUSTRALIAN SANDALWOOD (*SANTALUM SPICATUM*) NUT OIL KEY CONSTITUENTS



Key to functional group:

- sesquiterpenol
- aldehyde
- sesquiterpene
- monounsaturated omega-9 fatty acid
- polyunsaturated acetylenic fatty acid
- polyunsaturated omega-3/6 fatty acid
- C16 saturated fatty acid
- octadecanoic saturated fatty acid
- trans-unsaturated fatty acid

In India symbolic markings are drawn on the forehead with a paste made from the wood of Santalum album *trees. Applied in this way, Sandalwood's "cooling and soothing properties ... direct a person's attention towards contemplation of the mystery of life...Sandalwood is "the material of transformation and elevation". (McMahon, 2003)*

innately virtuous and healing. This special quality it has to instil purity - the heartwood itself protects and regenerates - is reflected in its remarkable antioxidant, anti-inflammatory, antimutagenic and anticancer activities (Santha & Dwivedi, 2013; 2015).

Sandalwood is used in the traditional Tibb-Unani system of medicine to treat gastric ulcers and diverse disorders including those of a cardiac, neurological, hepatic and dermal nature (Kausar *et al*, 2014). In Oriental medicine, sandalwood extracts are used to treat inflammatory skin disorders, dyspepsia and gastritis, genitourinary infections, and chronic anxiety (Misra & Dey, 2013).

Sandalwood's ancient reputation as a medicine for the body and mind, able to restore vitality as well as instil serenity, has been coupled with its widespread use in ritual space since time immemorial. A key temple incense and meditation aid, it gained over time an almost magical status - indeed, one of sanctity and transformation - throughout Asia and in Aboriginal Australia.

Sandalwood essential oil exerts an anti-inflammatory action in keeping with its ancient reputation as a cooling, soothing herbal paste and aromatic extract. Its anti-inflammatory activity combines with its antioxidant action to give it its remarkable chemopreventive, protective faculty.

In modern aromatherapy, sandalwood essential oil is commonly employed in aromatic formulae to relieve chronic nervous tension, anxiety and depression, depending on the precise condition of the individual (Setzer, 2009).

Possessing central nervous system depressant, neuroleptic and bronchial-dilating effects, the essential oil encourages improved sleep hygiene and a more restful night's sleep. α-santalol in particular has been shown to be readily absorbed into the blood via the circulatory system through the pulmonary mucosa (Ohmori *et al*, 2007).

In terms of palliative care, too, the results of a pilot study to evaluate the effectiveness of daily aromatherapy interventions support the observation that sandalwood essential oil, applied either transdermally or via olfaction-inhalation, is effective in reducing anxiety in palliative and end-of-life care (Kyle, 2006).

In terms of dermatology, sandalwood essential oil has been utilised topically for centuries in both Ayurvedic and traditional Oriental medicine.

Many skin conditions and diseases are characterised by inflammation, infection and *hyperplasia*; swelling and thickening. In general pathological terms, hyperplasia is the enlargement of an organ or tissue resulting from an increase in cellular reproduction rate - often an initial stage in the development of cancer. Sandalwood essential oil and its key constituents have been shown to exert an antiproliferative, anti-inflammatory action in keeping with its Oriental-energetic function of clearing Damp-Heat, thereby reducing swelling and thickening.

In clinical trials investigating its pharmacological mechanisms of action, sandalwood essential oil has been shown to be effective and safe in treating acne, psoriasis, eczema and common warts (Moy & Levenson, 2017). Its favourable safety profile and ease of topical use make it increasingly employed in the field of dermatology (Table 5).

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Part 2, scheduled to appear in our Spring/Summer 2023 edition, explores S. spicatum*'s anticancer activities and Oriental-energetic and scientific therapeutics.*

TABLE 5: Skin microbes against which Santalum essential oils have shown activity

GRAM-POSITIVE BACTERIA
Micrococcus glutamicus
Micrococcus flavus
Sarcina lutea
Propionobacterium acnes
Staphylococcus albus
Staphylococcus aureus
Staphylococcus aureus (MRSA)
Staphylococcus epidermidis
Streptococcus equisimilis
Streptococcus pyogenes

GRAM-NEGATIVE BACTERIA
Acinetobacter baumannii
Acinetobacter calcoaceticus
Klebsiella aerogenes
Klebsiella pneumoniae
Pseudomonas aeruginosa
Pseudomonas florescens
Pseudomonas putida

YEAST
Candida albicans
Candida krusei

FUNGI (DERMATOPHYTES)
Epidermophyton floccosum
Epidermophyton inguinale
Microsporum canis
Microsporum gypseum
Trichophyton asteroids
Trichophyton interdigitale
Trichophyton mentagrophytes
Trichophyton purpureum

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