

Review Article

Safety, efficacy and provenance of tea tree (*Melaleuca alternifolia*) oil

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The identity, sources and composition of tea tree (*Melaleuca alternifolia*) oil are discussed, and earlier errors in the literature indicated. Reports of both therapeutic and allergenic effects are reviewed.

Key words: tea tree oil; *Melaleuca alternifolia*; Melaleuca oil; chemical composition; contact allergy; antimicrobials; medicaments. © Munksgaard, 2001.

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A recent publication in this journal (1), while noting the infrequency of reports of contact dermatitis due to eucalyptol, referred to a case of contact dermatitis caused by eucalyptol distilled from *Malaleuca* (sic) *alternifolia* (2). This may give the impression that eucalyptol is routinely extracted from *Melaleuca alternifolia*. Eucalyptol, also known as 1,8-cineole, is the main component of eucalyptus oil harvested from various *Eucalyptus* species, including *Eucalyptus globulus* and *E. polybractea*, while *M. alternifolia* is the main commercial source of the essential oil known as tea tree oil. Although both the *Eucalyptus* and *Melaleuca* genera belong to the Myrtaceae family, the composition of the oils is markedly different.

The paper by Van der Valk *et al.* (2) describing 4 cases of allergy to tea tree oil reveals further confusion regarding eucalyptol and tea tree oil. The tea tree oil mentioned in the paper, allegedly sourced from *M. alternifolia*, is described as containing mainly eucalyptol. Both this paper and an earlier report of 1 of these cases (3) cite the major components of tea tree oil as α -pinene, β -pinene, ρ -cymene, eucalyptol, linalool, terpineol and β -caryophyllene. While this may have been the composition of the oil tested, it is not typical of tea tree oil distilled from *M. alternifolia* and it

is unlikely that it would meet the compositional requirements of the international standard for tea tree oil (4).

These discrepancies highlight some of the confusion surrounding the identity, sources and composition of tea tree oil. Other incorrect statements that have appeared in the literature recently include that tea tree oil must contain at least 30% terpinene (5), that *M. alternifolia* grows in Spain, Portugal, California and Oceania (3, 6), that “cajuput oil” is synonymous with tea tree oil (7), that there is cross-sensitization to or cross-reaction with colophonium (6, 8, 9) and that eucalyptol is probably the most important allergen (2).

Since 1996, the composition of tea tree oil has been regulated by the international standard for tea tree oil entitled “Oil of *Melaleuca* – terpinen-4-ol type (tea tree oil)” (4). Prior to this there was an Australian standard (10) and, notably, neither standard specifies which plant must be used to produce the oil. The Australian standard specified that the 1,8-cineole content of tea tree oil must not exceed 15%, while terpinen-4-ol content must exceed 30%. The international standard, that essentially supercedes the Australian standard, is more comprehensive and specifies compositional limits for 14 of the approximately

Table 1. Compositional requirements for tea tree oil^{a)}

Component	Minimum (%)	Maximum (%)
terpinolene	1.5	5
1,8-cineole	—	15
α -terpinene	5	13
γ -terpinene	10	28
ρ -cymene	0.5	12
terpinen-4-ol	30	—
α -terpineol	1.5	8
limonene	0.5	4
sabinene	traces	3.5
aromadendrene	traces	7
δ -cadinene	traces	8
globulol	traces	3
viridiflorol	traces	1.5
α -pinene	1	6

^{a)} From ref. (4).

100 components (11) (Table 1). A terpinen-4-ol content in excess of 30% of the oil is still required (4), although in practice this is often approximately 40% of the oil.

Tea tree oil is produced mainly from *M. alternifolia* on large-scale plantations in the states of New South Wales and Queensland in Australia. Prior to commercial cultivation, the natural habitat of *M. alternifolia* was limited to the area around the Clarence and Richmond Rivers in north-eastern coastal New South Wales. Other *Melaleuca* species, including *M. dissitiflora* and *M. linariifolia*, have produced oils which meet the international standard (12), and the possibility remains that additional species may be found that produce equivalent oils.

Verifying the botanical origin of an essential oil is sometimes difficult, due to the widespread use of common names that do not adequately identify source plants. There are several historical terms for tea tree oil, including "melaleuca oil" and "ti tree oil", "ti tree" being a Maori and Samoan common name for plants in the genus *Cordyline* (13). Use of the term "melaleuca oil" is potentially misleading since several chemically distinct oils are distilled from other *Melaleuca* species such as "cajuput" oil (also "cajeput" or "cajaput") from *M. cajuputi* and "niaouli" oil from *M. quinquenervia* (often misidentified as *M. viridiflora*) (14). However, the term "Melaleuca oil" has been selected as the official approved name by the Therapeutic Goods Administration of Australia.

The use of common plant names further confounds the issue. In Australia, "tea trees" are also known as "paperbark trees" and collectively these terms may refer to species in the *Melaleuca* or *Leptospermum* genera, of which there are several hundred. For instance, common names for *M. cajuputi* include "swamp tea tree" and "paperbark tea tree", while those for *M. quinquenervia* include

"broad-leaved tea tree" and "broad-leaved paperbark" (14). Many *Leptospermum* species are cultivated domestically and these are often mistaken as a source of tea tree oil. In addition, the essential oils derived from the New Zealand plants *Kunzea ericoides* and *Leptospermum scoparium*, and known commonly as kanuka and manuka oils, respectively, are often referred to as New Zealand tea tree oils, although they are very different in composition (15).

There are numerous reports in the literature of positive patch tests to tea tree oil (2, 3, 6–8, 16, 17). However, the composition of the oil in 2 reports (2, 3) does not meet the requirements of the international standard or its Australian predecessor. The identity of the tea tree oil in another report (7) is questionable, since the term "cajeput" is used as a synonym and no compositional data are given. The suggestion that tea tree oil can cross-sensitize to colophonium is also tenuous. The original case report (6) does not document cross-reaction between colophonium and tea tree oil or cross-sensitization to colophonium by tea tree oil, or *vice versa*. It merely reports the co-incidence of positive patch tests to both substances. No causal link between the 2 has been demonstrated (17).

Some effort has been made to identify the tea tree oil components responsible for allergic reactions and those found include 1,8-cineole (3), D-limonene, α -terpinene, aromadendrene, terpinen-4-ol, α -phellandrene, ρ -cymene, α -pinene, terpinolene (18) and α -terpinene (19). Other work (20, 21) suggests that oxidation products are the likely allergens. Since oxidized tea tree oil appears to be a more potent allergen than fresh tea tree oil, adverse reactions may be minimized by reducing exposure to aged, oxidized oil. Additional work is required to determine the extent of these effects, suitable parameters of stability and appropriate formulation and storage procedures.

In vitro data suggest that tea tree (*M. alternifolia*) oil is a potentially useful topical antimicrobial agent (22–24) and recent clinical trials have shown promise (25, 26). More data concerning the in vivo efficacy and safety of tea tree oil are required. However, if its biological properties, including its allergenicity, are to be assessed objectively, accurate information about the oil and its properties must be reported in the literature.

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