Tea Tree Oil

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Tea tree oil is an increasingly popular ingredient in a variety of household and cosmetic products, including shampoos, massage oils, skin and nail creams, and laundry detergents. Known for its potential antiseptic properties, it has been shown to be active against a variety of bacteria, fungi, viruses, and mites. The oil is extracted from the leaves of the tea tree via steam distillation. This essential oil possesses a sharp camphoraceous odor followed by a menthol-like cooling sensation. Most commonly an ingredient in topical products, it is used at a concentration of 5% to 10%. Even at this concentration, it has been reported to induce contact sensitization and allergic contact dermatitis reactions. In 1999, tea tree oil was added to the North American Contact Dermatitis Group screening panel. The latest prevalence rates suggest that 1.4% of patients referred for patch testing had a positive reaction to tea tree oil.

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TEA TREE oil is a pale yellow essential oil extracted from the leaves of the *Melaleuca alternifolia* plant of the Myrtaceae family. It is well known for its medicinal and potential cosmetic uses and is reportedly used for its antiseptic,[1,2] antifungal,[3,4] and antiviral[5] properties. This native shrub grows on the northeastern Australian coast, often alongside bodies of water. The oil from the crushed leaf was first used as an aromatherapy agent by the indigenous Australian Bundjalung tribe to treat upper respiratory tract infections.[6,7] In the 1920s, researchers Penfold and Grant[8] published the first reports of the potential antiseptic activity of tea tree oil, describing it as 11 times more active than phenol.

Of interest, commercial production continued until the mid-1940s, when it was slowly phased out with the introduction of more effective oral antibiotic medications and topical antiseptics.[6] With the increasing popularity of "natural" products in the 1970s, however, commercial farming of *M. alternifolia* began on large plantations in the Australian states of New South Wales and Queensland. Currently, these production facilities not only grow tea trees but also steam-distill the leaves on site to manufacture a uniform product.[9,10]

The composition of tea tree oil has been regulated since 1996 by the International Organization for Standardization (ISO); the oil is labeled "oil of Melaleuca—terpinen-4-ol type (tea tree oil)."[11] Although the oil contains more than 100 compounds, the ISO specifies the top 15 compounds needed for the product to be labeled "tea tree oil" (Table 1). Of note, the international classification does not require that the oil be produced from *M. alternifolia*, and there have been reports that oils that meet the international standard requirements have been produced from other Melaleuca species (such as *Melaleuca dissitiflora* and *Melaleuca linariifolia*).[7,12]

Although generally considered a safe product when used topically, tea tree oil is considered toxic when swallowed. Reactions to ingestion of the oil range from vomiting and diarrhea to hallucinations and coma.[7,13] In addition, a recent case series reported in the *New England Journal of Medicine* suggested a potential connection between prepubertal gynecomastia and lavender and tea tree oils.[14] However, only 1 of the 3 patients in that study was using a product containing tea tree oil; in all cases, the gynecomastia reversed after several months.

The main safety concern with topical tea tree oil preparations is their potential to induce allergic contact dermatitis (ACD). The allergenic compounds in tea tree oil have been investigated and include 1,8-cineole,[15] D-limonene, α-terpinene, aromadendrene, terpinen-4-ol, α-phellandrene, ρ-cymene, α-pinene, terpinolene,[16] and α-terpinene.[17] It should be noted that oxidized tea tree oil has been found to be a more potent contact allergen than the fresh form of the oil, suggesting that oxidation products may be the likely allergens.[18,19] Unfortunately, the evaluation of tea tree oil as a potential contact allergen is incredibly challenging, not only because tea tree oil consists of more than 100 distinct compounds but also because the oil is often mislabeled or does not meet ISO guidelines.[7,9] Furthermore, the most sensitizing components may not be chemicals in the oil itself but rather degradation products that are formed when the oil is applied to the skin.[7]

A number of cases of ACD from tea tree oil are cited in the literature.[20–25] The reported presentations are variable and range from erythema and pruritus to eczematous plaques at topical application sites to bullous and erythema multiforme–like reactions.[7] Of note, there has been 1 reported case of linear immunoglobulin A induced by tea tree oil.[7] Reactions have been reported as occurring equally in males and females, and there does not appear to be a preferred site of involvement.[7] Although patients as young as 17 years and as old as 76 years have been reported, most patients were in their 50s to 70s and had previous exposure to products containing tea tree oil.[7]

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TABLE 1. Constitutional Requirements for Tea Tree Oil

Component	Minimum, %	Maximum, %
α-Pinene	1.0	6.0
Sabinene	Trace	3.5
α-Terpinene	5.0	13.0
ᴅ-Limonene	0.5	1.5
ρ-Cymene	0.5	8.0
1,8-Cineol (eucalyptol)	Trace	15.0
γ-Terpinene	10.0	28.0
Terpinolene	1.5	5.0
Terpinen-4-ol	30.0	48.0
α-Terpineol	1.5	8.0
Aromadendrene	Trace	3.0
Ledene (viridoflorene)	Trace	3.0
δ-Cadinene	Trace	3.0
Globulol	Trace	1.0
Viridiflorol	Trace	1.0

The potential allergenicity of tea tree oil is considered low. In a selected population of healthy volunteers of whom 63% had prior exposure to tea tree oil, the prevalence of ACD reactions to a 10% dilution ranged from 2.9% to 4.8%, respectively, not including or including "indistinguishable reactions."[26] On the other hand, Lisi and colleagues[26] tested 725 consecutive patients suspected of having ACD with undiluted, 5%, 1%, and 0.1% tea tree oil preparations in petrolatum; nearly 6% of the patients had patch-test reactions to the undiluted preparation, whereas only 1 patient had a true positive reaction to the 1% dilution. The high reactivity rate with the undiluted preparation suggested that irritancy may occur with the concentrated product and that the lower concentrations may not "capture" all allergic patients. In a subsequent study, Veien and colleagues[27] found that only 1 of 217 consecutively tested patients had a relevant positive patch-test reaction to tea tree oil at a 10% concentration.[28] Of note, tea tree oil was added to the North American Contact Dermatitis Group screening panel in 1999. The latest available data from the North American Contact Dermatitis Group indicate a low prevalence of 1.4%.

In summary, although the prevalence of tea tree oil allergy is low, it should remain on the allergen differential for ACD especially because the oil is present in a wide variety of consumer products. When the index of suspicion remains high, patch testing both with 5% tea tree oil in petrolatum and with the patient's own products is recommended.

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