

## Tea Tree

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A member of the family Myrtaceae, the tea tree (*Melaleuca alternifolia*) is one of over 150 species of *Melaleuca*, which is indigenous to Australia. The tea tree grows in swampy, low-lying areas on the northern coast of New South Wales, where the leaves of the tree have been used by aborigines for centuries as a local antiseptic. Later settlers began to use the leaves to treat a variety of skin disorders such as cuts, burns, insect bites, and athlete's foot. The leaves are the medicinally useful part of the plant and contain a volatile essential oil known as tea tree oil. Less commonly, tea tree oil is extracted from *M. linariifolia* and *M. dissitiflora*. Tea trees, also called paper bark trees, were named by Captain James Cook, who first brewed a tea from the leaves soon after arriving at the coast of New South Wales in 1770. Soon the use of tea tree oil spread, and it is now popular all over the world as a natural antimicrobial agent. As the demand for tea tree oil increased, tea tree plantations were established in Australia. Cultivated from seed, tea tree leaves can be harvested from a plant in about 12-18 months. Seeds from hearty trees growing in the wild have been collected, and, through years of selection, the quality of the oil extracted from the leaves has improved.<sup>1</sup>

### Chemical Composition and Active Constituents

Tea tree oil is steam-distilled primarily from the leaves of *M. alternifolia*. The leaves contain 2% of a pale-yellow volatile oil. Approximately one-third of this essential oil fraction is composed of terpene hydrocarbons such as beta-pinene, p-cymene, limonene, aromadendrene, 1-8 cineole and many others. The remaining portion of the essential oil fraction is composed of oxygenated terpenes, with 30-70% made up of terpinen-4-ol.<sup>2</sup> Terpinen-4-ol appears responsible for most of the antimicrobial activity of tea tree oil. Terpinolene (1-2%), alpha-terpineol (1-2%), and alpha-terpinene are other abundant terpenes present. The Australian standard "Oil of *Melaleuca*" contains 30-77% terpinen-4-ol and less than 15% cineole. Tea tree oils with high cineole content are thought to be of poor quality and more likely to cause skin irritation.<sup>3</sup>

### Medicinal Uses and Pharmacology

**Antifungal Effects:** Recent evidence supports the use of tea tree oil to treat yeast and fungal infections of the skin and mucosa. Since 1992, several well-controlled clinical trials, some directly comparing tea tree oil with a conventional treatment, have been published. A randomized, double-blind trial in 104 patients with tinea pedis

compared 10% w/w tea tree oil cream with 1% tolnaftate and placebo.<sup>4</sup> Tolnaftate (Tinactin) is a thiocarbamate synthetic antifungal that has an 80% cure rate for tinea pedis. Both treatment groups showed significant improvements in clinical symptoms; however, only tolnaftate showed conversion to negative culture at the end of therapy.

**Terpinen-4-ol appears responsible for most of the antimicrobial activity of tea tree oil.**

In a double-blind, multicenter, randomized, controlled trial involving 117 patients with nail fungus (onychomycosis), infections were treated for six months with twice-daily topical applications of either 1% clotrimazole or 100% tea tree oil.<sup>5</sup> At the end of treatment, both groups showed similar positive results. There was a decrease in fungus in cultures as well as a clinically documented resolution of the infection with both products. Tea tree oil has also effectively eliminated head lice (*Pediculus humanus capitis*) when applied in an alcoholic solution to the scalp.<sup>6</sup> Growth of *Pityrosporum ovale*, the organism that causes seborrheic dermatitis and dandruff, appears to be inhibited by tea tree oil.<sup>1</sup> Topical scalp preparations with the oil may be effective in this condition, but clinical trials have not been conducted.

Several in vitro studies have revealed that tea tree oil inhibits the growth of many species and strains of fungi and yeast. The

antifungal activity of tea tree oil (0.5%) was tested against 26 strains of dermatophytes and 54 yeast strains (including 32 strains of *Candida albicans* and 22 strains of *Malassezia furfur*).<sup>7</sup> Tea tree oil inhibited the growth of all of these fungal strains. In another study, the susceptibility of 64 *M. furfur* strains to tea tree oil was examined.<sup>8</sup> For 90% of the strains, the minimum inhibitory concentration of tea tree oil was 0.25%. In another study, tea tree oil inhibited the growth of *C. albicans*, *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Trichophyton tonsurans*, *Aspergillus niger*, and *Microsporum gypsum*.<sup>9</sup> Two reports indicate successful treatment of vaginal yeast infections with tea tree oil.<sup>10,11</sup> Treatment required 4-7 weeks for yeast eradication and relief of symptoms.

**Antibacterial Effects:** In vitro studies show the effectiveness of tea tree oil in inhibiting several common skin pathogens. Terpinen-4-ol and whole tea tree oil were found equally effective for activity against *Staphylococcus aureus*.<sup>1</sup> Ramon and associates tested several major components of tea tree oil (terpinen-4-ol, alpha-terpineol, alpha-pinene, and cineole) for their effects against *S. aureus*, *Staphylococcus epidermidis*, and *Propionibacterium acnes*.<sup>12</sup> Except for cineole, all of the constituents tested were inhibitory to all three organisms.

*P. acnes* is the major bacterium that causes acne vulgaris. The effectiveness and skin tolerance of tea tree oil as a treatment was evaluated in a single-blind, randomized clinical trial involving 124 patients.<sup>13</sup> Treatment efficacy of a 5% tea tree oil gel was compared with that of a 5% benzoyl peroxide lotion. Both treatments significantly reduced the number of inflamed and noninflamed lesions. Tea tree oil had a much slower onset of action but also had fewer adverse side effects, such as skin scaling, dryness, and irritation. In an in vitro study, the susceptibility of 66 isolates of *S. aureus* to tea tree oil was investigated.<sup>14</sup> All of the isolates were inhibited by tea tree oil, with a minimum concentration of 0.25%. In another study, Burnaid, a sorbalene-based cream containing 40 mg/g of tea tree oil as well as 1 mg/g of triclosan, was tested for inhibitory effects on several infectious microorganisms common in burn patients: 15 *Enterococcus faecalis*, *S. aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Burnaid significantly inhibited only *S. aureus* and *E. coli*. Another recent study demonstrated that tea tree oil stimulated autolysis in stationary phase cells of *E. coli*.<sup>16</sup> Electron micrographs of cells grown in the presence of tea tree oil showed the loss of electron-dense material, formation of extracellular blebs, and coagulation of cell cytoplasm.

**Other Reported Medicinal Uses:** Tea tree oil is used in a number of pet shampoos to kill ticks and fleas and is claimed to repel insects. It is also used to treat the itching of insect bites. It is popularly thought to be effective in treating sinus, bronchial, and throat infections when a few drops are added to hot water and the vapors are inhaled. Applying tea tree oil to sore muscles is thought to have an analgesic effect. Tea tree oil added to warm water and used as a mouthwash is a common remedy to help protect against periodontal disease and gingivitis. It is also widely used to treat canker sores and warts. None of these uses are supported by experimental evidence.

### Toxicity and Adverse Reactions

Recent evidence has demonstrated that exposure to tea tree oil can lead to allergic contact dermatitis in susceptible individuals. At the Skin and Cancer Foundation in Sydney, Australia, three of 28 normal volunteers were positive to patch testing with tea tree oil.<sup>17</sup> Further testing of tea tree oil constituents showed that all three patients were responding to the sesquiterpenoid fraction of the essential oil. In an earlier study, seven patients who had become sensitized to tea tree oil were exposed to 1% tea tree oil and 1% solutions of 11 isolated individual constituents.<sup>18</sup> Of the seven patients who reacted to 1% tea tree oil, six also reacted to limonene, five to alpha-terpinene and aromadendrene, two reacted to terpinen-4-ol and one each to p-cymene and alpha-phellandrene. These reports indicate that several components of tea tree oil are capable of causing allergic skin reactions.

Interestingly, cases of tea tree oil toxicity have been reported by veterinarians to the National Animal Poison Control Center.<sup>19</sup> When high doses are applied dermally to cats or dogs, signs of depression, weakness, incoordination and muscle tremors are sometimes seen. In humans, one case reported a 17-month old male child ingesting approximately 10 mL of tea tree oil.<sup>20</sup> The child showed symptoms of ataxia and drowsiness. In a similar case, a 23-month old boy consumed 10 mL of a commercial product containing 100% tea tree oil.<sup>21</sup> He experienced similar symptoms of confusion and was not able to walk 30 minutes after ingesting the product.

### Dosage and Recommendations

Tea tree oil concentrations ranging from 0.25%, .5% have demonstrated in vitro antibacterial as well as antifungal activity.<sup>8,9,14</sup> This range is significantly lower than that usually topically applied (1.0% -.05%) for treating microbial infections. Tea tree preparations containing 10% and 100% tea tree oil were utilized in clinical trials to treat tinea pedis and nail fungus, respectively.<sup>4,5</sup> For treating athlete's foot, it is advised to dilute the concentrated oil with an equal amount of water or vegetable oil and apply to the affected area three times a day with a cottonball.<sup>22</sup> A topically applied 5% solution appears to be effective in treating acne.<sup>13</sup> These clinically proven effective dosages can be a guide, along with the manufacturer's instructions, for using tea tree oil as an antimicrobial agent.

Most of the clinical studies that demonstrated skin irritations and allergies utilized 1% tea tree oil preparations.<sup>18</sup> Therefore, the

commonly used topical concentrations are likely to elicit allergic responses in susceptible individuals. Because of demonstrated systemic toxic effects, tea tree oil should never be used internally.

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