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Review Article

An Overview on Tea Tree (*Melaleuca Alternifolia*) Oil

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Abstract

Tea tree oil, an essential oil extracted from the leaves of *Melaleuca alternifolia* by steam distillation and supercritical fluid extraction has found a wide range of antimicrobial activities as antiviral, antifungal, antibacterial due to the presence of terpinen-4-ol as the major constituent. Tea tree oil is natural products, so it is non-toxic, easily accessible, biodegradable, and biocompatible. The several advantages of tea tree oil make it one of the beneficial product having therapeutic effects. The present review article is based on the application of tea tree oil, extraction process of tea tree oil, constituents, safety considerations etc.

1. INTRODUCTION

Tea tree oil is an essential oil which is extracted from the leaves of the *Melaleuca alternifolia*. It has a camphoraceous odor and a color that ranges from pale yellow to nearly colorless¹.

1.1 History of production

Traditionally, *Melaleuca alternifolia* leaves were crushed and the oil was inhaled by the indigenous Bundjalung people of eastern Australia for the treatment of coughs, colds and also for the treatment of wounds. An infusion of *Melaleuca alternifolia* leaves was used to treat sore throats or skin ailments^{2, 3}. The essential beneficial effects of *Melaleuca alternifolia* oil came into focus when the first reports of its anti-microbial activity were published in a series of papers in the 1920s and 1930s. The use of tea tree oil in industry came into existence when the antimicrobial activities of *Melaleuca alternifolia* were first reported by Penfold and was rated to be 11 times more active than phenol. But after World War II, the entry of antibiotics declined the use of natural products in medicine, which has negative effect on the production of tea tree (*Melaleuca alternifolia*) oil. The interest in natural products like tea tree oil grew in the year 1970s which appeared as a period of general renaissance of natural products. Commercial plantations were established in the 1970s and 1980s, which led to a large-scale production of a consistent essential oil product^{4, 5}.

Although tea tree oil normally is extracted from *Melaleuca alternifolia* commercially, it can also be extracted from *Melaleuca dissitiflora* and *Melaleuca linariifolia*⁵.

Till now tremendous researches have been done on the antifungal, antibacterial and antiviral activity of tea tree oil.

1.2 Antimicrobial activity of Tea tree oil

A positive antifungal activity of tea tree oil was found when tested *in vitro* on twelve plant pathogenic fungi (*Fusarium graminearum*, *F. verticillioides*, *F. subglutinans*, *F. oxysporum*, *F. avenaceum*, *Diaporthe helianthi*, *Diaporthe phaseolorum var. caulivora*,

Phomopsis longicolla, *P. viticola*, *Helminthosporium sativum*, *Colletotrichum coccodes*, *Thanatephorus cucumeris*)⁶. In another, it was reported that tea tree oil is inhibiting the growth rate of *Candida albicans* and also *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Trichophyton tonsurans*, *Aspergillus niger*, *Penicillium* species when tested *in vitro*⁷. Tea tree oil loaded on nanocapsules and nanoemulsions reported to inhibit the growth of *Trichophyton rubrum* in two different *in vitro* models of dermatophyte nail infection⁸. Tea tree oil components- terpinen-4-ol, alpha-terpineol was reported to inhibit the formation of biofilms by *Candida albicans*, and thus can be used for the treatment of oropharyngeal candidosis in cancer patients caused by *Candida albicans*⁹. It was reported that tea tree oil might be a promising alternative of air disinfection in animal houses as its antibacterial activity was proven and the minimum inhibitory concentration (MIC) was obtained by broth dilution technique were 5.0% for *Pseudomonas aeruginosa* and *Enterococcus faecium*, and 8.0% for *Staphylococcus aureus*¹⁰. It was reported that encapsulation of tea tree oil in a controlled release liposomal carrier system not only enhances their antimicrobial efficacy against *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Candida albicans* but also reduces the effective concentration required in conventional dosage forms. This in turn reduces the requirement of high effective doses for conventional dosage forms or microbial resistance occurrence when long term application is required¹¹. Tea tree oil aerosols were found to have antiviral activity against Influenza A virus and *E. coli* phage M13 tested *in vitro*¹². Among the different components of tea tree oil, terpinen-4-ol, alpha-terpineol, linalool, alpha-pinene and beta-pinene; terpinen-4-ol as been found to have the most antifungal activity, with minimum inhibitory concentrations and minimum fungicidal concentrations of < or =0.25% followed by 1, 8-cineole¹³.

1.3 Composition

The tea tree oil (*Melaleuca alternifolia*) report approximately 100 components of different concentrations whose composition are regulated by an international Organization for Standardization standard as (ISO4730). The major component of tea tree oil is terpinen-4-ol which is found to have anti microbial activity. The components of tea tree oil are shown in Table 1¹.

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Table 1: Components of tea tree oil

Components	Concentrations
terpinen-4-ol	30–48%
γ-terpinene	10–28%
α-terpinene	5–13%
1,8-Cineole	0–15%
α-terpinolene	1.5–5%
α-terpineol	1.5–8%
α-pinene	1–6%
p-Cymene	0.5–8%

2. EXTRACTION OF TEA TREE OIL

Tea tree oil is extracted by steam distillation of the leaves and terminal branches of *Melaleuca alternifolia*. Once condensed, the clear to pale yellow oil is separated from the aqueous distillate. The yield of oil is typically 1 to 2% of wet plant material weight¹⁴. Supercritical fluid extraction (SFE) is also used for the extraction purpose under a range of supercritical carbon dioxide (scCO₂) densities and chamber temperatures at flow rate of 0.25 g/mL scCO₂ density at a chamber temperature of 110°C. Supercritical fluid extraction overcomes the drawbacks associated with steam distillation process like loss of components due to thermal degradation, hydrolysis or volatilization. On the other hand, Supercritical fluid extraction is non-toxic and cheap involving little or no organic solvents, safe extraction of thermolabile compounds, extraction conditions can be effectively controlled through temperature and/or pressure modifications, easy achievement of the supercritical state (scCO₂) since CO₂ possesses a critical temperature of 31°C¹⁵.

3. APPLICATION OF TEA TREE OIL

The major component of the Tea Tree Oil, terpinen-4-ol, which is extracted from leaves of *Melaleuca alternifolia*, has been found to have several medicinal effects as an anti-inflammatory effect, antibacterial, onychomycosis, candidiasis, clearance of bronchial congestion; effective in asthma, coughs, sinusitis, whooping cough, tuberculosis, antifungal and an anticancer activity in human melanoma cell lines (M14) as well as in lung cancer cells¹. Due to its intrinsic properties, terpinen-4-ol can cause allergic reactions when applied directly in the skin, limiting its use¹⁶. To reduce the skin irritation, tea tree oil is delivered using some carrier systems as shown in Table 2.

Table 2: Tea tree oil carriers and its application

Sr. No.	Tea tree oil carrier system	Applications
1	Zein nanoparticles ¹⁶	Anticancerous activity
2	PEG stabilized lipid nanoparticles ²⁵	Antimicrobial activity
3	Topical cream ²⁶	Burn treatment
4	Microemulsion transdermal drug delivery ²⁷	Psoriasis
5	Hydrogel thickened nanoemulsion ²⁸	Anti-inflammatory
6	Microemulsion Based Transdermal Drug Delivery ²⁹	Psoriasis

The Tea tree oil is effective for the treatment of cuts and grazes, acne, herpes, dandruff, muscle aches, tension, strains, rheumatic complaints, sunburn and bronchial infections and also boosts the immune system. It is also most effective to help on the genitourinary system, it can be used to help clear vaginal thrush, cystitis and genital infections in general and on the skin, clears abscesses, acne, burns, herpes, oily skin, athlete's foot, cold sores, blemishes, diaper rash, warts, sunburn and infected wounds¹⁷. The Tea tree oil is one of the most powerful immune stimulant oils and helps fight infections of all kinds and helps clear the skin¹⁸. Some of the applications of Tea tree oil include:

3.1 Burners and vaporizers¹⁹

In vapour therapy, Tea tree oil helps with colds, sinusitis, bronchitis and any other respiratory ailment and is also of use to help the mind cope after shock.

3.2 Blended massage oil or in the bath¹⁹

As a blended massage oil or diluted in the bath, Tea tree oil helps with all respiratory ailments, as well as arthritis, colds, dermatitis, skin infections, scalp disorders, sinusitis, viral infections, nettle rash, babies colds and coughs, bronchitis, as well as for sweaty feet.

3.3 In wash or applied neat²⁰

When it is added to the water for washing it has great value to treat abscesses, bed sores, acne, boils, lice, dandruff, wounds, as well as animal or human bites and can also be applied neat on problem areas with a cotton bud.

For lice - apply neat onto the scalp - leave for 40 minutes and wash the hair. This must be repeated every second day for twelve days. Fungal outbreaks such as athlete's foot and nail infections (paronychia) as well as vaginal thrush and cradle cap can be treated with frequent direct application of a 2.5% dilution of tea tree oil.

3.4 Mouthwash²¹

The Tea tree oil can be used as a mouthwash for gum infections, mouth ulcers, throat infections and tonsillitis, while garlic eaters believe that it reduces the smell of garlic on the breath.

3.5 Cream or lotion²²

When Tea tree oil is blended into a cream or lotion and applied to the skin, it will help to clear up any fungal, bacterial as well as viral infections - and can therefore be used for a variety of problems - ranging from boils, abscesses, acne, bite wounds from animals and humans (although a medical practitioner must also be consulted), dandruff and other scalp disorders and is also effective to help sort out bed sores, diaper rash or any other rashes.

The Tea tree oil has been shown to inhibit cellular respiration in *E. coli*, and by disrupting the permeability barrier of microbial membranes the oil causes the cells to die²³. There is the death of *E. coli*, *Proteus mirabilis*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* after exposure to a mixture of tea tree oil and jojoba oil²⁴. The Tea tree oil has the ability to control the growth of five bacteria *Bacillus subtilis*, *Escherichia coli*, *Micrococcus roseus*, *Sarcina luteus*, and *Serratia marcescens*.

SAFETY USE^{30, 31}

- The American Cancer Society has reported toxicity of Tea tree oil when swallowed causing drowsiness, confusion, hallucinations, coma, unsteadiness, weakness, vomiting, diarrhoea, stomach upset, blood cell abnormalities, and severe rashes. It should be kept away from pets and children.
- Dermatitis on contact with Tea tree oil due to the various oxidation products that are formed by exposure of the oil to light and/or air.
- High dose when administered to dog, cats show signs of toxicity such as depression, weakness, incoordination and muscle tremors, have been reported.
- Repeated use of Tea tree oil may cause endocrine disrupting activity leading to gynecomastia. Care should be taken while selecting the concentration of tea tree oil.

The Tea tree oil can be used in blend with Basil, black pepper, chamomile german, clove, eucalyptus, geranium, lemon, nutmeg, peppermint, rosemary, thyme etc.

The several advantages of Tea tree oil make its use high in several fields and depending on its application, it is classified as

- Industrial Tea tree oil (use in cleaners, disinfectants and agricultural products)
- Technical Tea tree oil (use in animal care products)
- Cosmetic Tea tree oil (use in body care products)
- Pharmaceutical quality (maximum quality: over 30% terpinen-4 oil content and less than 5% cineol content)

Few examples of marketed products of tea tree oil are as under:

Table 3: Marketed products of Tea tree oil

Marketed Products
Toners
Alkeme Gesichts Wasser Toner ³²
The Body Shop @Tea Tree Skin Clearing Toner ³³
Face cream
Alkeme Gesichtscream Face cream ³⁴
Restorativ® Tea Tree & Vitamin E Moisturizing Cream ³⁵
Oriflame Pure Nature ORGANIC Tea Tree and Rosemary Oil Purifying Face Cream ³⁶
Mouthwashes
Desert Essence Tea Tree Oil Mouthwash ³⁷
Shampoos ³⁸
Jovees Thyme and Tea Tree Anti Dandruff Shampoo
Health Aid Tea Tree Shampoo
Paul Mitchell Tea Tree Special Shampoo
Patanjali Kesh Kanti Shampoo with Rosemary and Tea Tree Oil
Avalon Organic Tea Tree Shampoo
Avon Naturals Tea Tree and Mint Anti Dandruff Shampoo
Facewash
Ayur Tea Tree Face Wash for Acne-Prone & Oily Skin ³⁹
Oriflame Tea Tree Purifying Wash and Tone Gel ⁴⁰
Jovees Tea Tree Oil Face Wash ⁴¹
Avon Purifying - tea tree oil and green tea Face Wash ⁴²
The Body Shop Tea Tree Oil Facial Wash ⁴³

5. CONCLUSION

This review clarifies the widespread applications of Tea tree (*Melaleuca alternifolia*) oil in cosmetics, healthcare and antiseptic products due to its antibacterial, antifungal, antiviral, anti-inflammatory and analgesic properties. Thus Tea tree (*Melaleuca alternifolia*) oil is highly significant as a naturally available medicinal plant extract.

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