Review Article
An Overview on Tea Tree (Melaleuca Alternifolia) Oil

Sunita Lahkar¹, Malay Kumar Das², Sudarshana Bora³

¹ Department of Pharmacy, Assam Downtown University, Guwahati 781026, Assam, India.
² Department of Pharmaceutical Sciences, Dibrugarh University, Dibrugarh 786004, Assam, India.
³ Regional Medical Research Centre (NE Region), Indian Council of Medical Research, Dibrugarh 786001, Assam, India.

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 colorless.³

1.1 History of production
Traditionally, Melaleuca alternifolia leaves were crushed and the oil was inhale 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 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.² Although tea tree oil normally is extracted from Melaleuca alternifolia commercially, it can also be extracted from Melaleuca dissitiflora and Melaleuca linariifolia.⁴ 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). 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. 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 infection.⁴ 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.³ 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.⁶ 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 required.⁷ Tea tree oil aerosols were found to have antiviral activity against Influenza A virus and E. coli phage M13 tested in vitro.⁸ 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 of < or =0.25% followed by 1, 8-cineole.⁹

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 1.

---

*Corresponding Author:
Sunita Lahkar,
Department of Pharmacy,
Assam Downtown University,
Guwahati 781026, Assam, India
Email: sunitalakhar@gmail.com
Table 1: Components of tea tree oil

<table>
<thead>
<tr>
<th>Components</th>
<th>Concentrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>α-terpinene</td>
<td>10–28%</td>
</tr>
<tr>
<td>α-terpineol</td>
<td>5–13%</td>
</tr>
<tr>
<td>1,8-Cineole</td>
<td>0–15%</td>
</tr>
<tr>
<td>α-terpinolene</td>
<td>1.5–5%</td>
</tr>
<tr>
<td>α-pinene</td>
<td>1–6%</td>
</tr>
<tr>
<td>p-Cymene</td>
<td>0.5–8%</td>
</tr>
</tbody>
</table>

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 weight.14

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 thermostable 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°C.25

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, antifungal, 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 cells.22 Due to its intrinsic properties, terpinen-4-ol can cause allergic reactions when applied directly on the skin, limiting its use.22 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

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Tea tree oil carrier system</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zein nanoparticles22</td>
<td>Anticancerous activity</td>
</tr>
<tr>
<td>2</td>
<td>PEG stabilized lipid nanoparticles23</td>
<td>Antimicrobial activity</td>
</tr>
<tr>
<td>3</td>
<td>Topical cream24</td>
<td>Burn treatment</td>
</tr>
<tr>
<td>4</td>
<td>Microemulsion transdermal drug delivery25</td>
<td>Psoriasis</td>
</tr>
<tr>
<td>5</td>
<td>Hydrogel thickened nanoemulsion26</td>
<td>Anti-inflammatory</td>
</tr>
<tr>
<td>6</td>
<td>Microemulsion Based Transdermal Drug Delivery26</td>
<td>Psoriasis</td>
</tr>
</tbody>
</table>

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 genito-urinary 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 wounds. The Tea tree oil is one of the most powerful immune stimulant oils and helps fight infections of all kinds and helps clear the skin. Some of the applications of Tea tree oil include:

3.1 Burners and vaporizers

In vapor 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 bath

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 neat

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 (onychomycosis) 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 Mouthwash

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 lotion

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 die. 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 oil27. The Tea tree oil has the ability to control the growth of live bacteria Bacillus subtilis, Escherichia coli, Micrococcus ruseus, Sarcina luteus, and Serratia marcescens.

SAFETY USE28,31

1. The American Cancer Society has reported toxicity of Tea tree oil when swallowed causing drowsiness, confusion, hallucinations, coma, unsteadiness, weakness, vomiting, diarrhea, stomach upset, blood cell abnormalities, and severe rashes. It should be kept away from pets and children.

2. 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.

3. High dose when administered to dog, cats show signs of toxicity such as depression, weakness, incoordination and muscle tremors, have been reported.

4. 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-ol content and less than 5% cineol content)
Few examples of marketed products of tea tree oil are as under:

<table>
<thead>
<tr>
<th>Table 3: Marketed products of Tea tree oil</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marketed Products</strong></td>
</tr>
<tr>
<td><strong>Toners</strong></td>
</tr>
<tr>
<td>Alkeme Gesichts Wasser Toner&quot;</td>
</tr>
<tr>
<td>&quot;The Body Shop® Tea Tree Clearing Toner&quot;</td>
</tr>
<tr>
<td><strong>Face cream</strong></td>
</tr>
<tr>
<td>Alkeme Gesichtscream Face cream&quot;</td>
</tr>
<tr>
<td>Restorativ® Tea Tree &amp; Vitamin E Moisturizing Cream&quot;</td>
</tr>
<tr>
<td>Oriflame Pure NATURE ORGANIC Tea Tree and Rosemary Oil Purifying Face Cream&quot;</td>
</tr>
<tr>
<td><strong>Mouthwashes</strong></td>
</tr>
<tr>
<td>Desert Essence Tea Tree Oil Mouthwash&quot;</td>
</tr>
<tr>
<td>Shampoos&quot;</td>
</tr>
<tr>
<td>Jovees Thyme and Tea Tree Anti Dandruff Shampoo</td>
</tr>
<tr>
<td>Health Aid Tea Tree Shampoo</td>
</tr>
<tr>
<td>Paul Mitchell Tea Tree Special Shampoo</td>
</tr>
<tr>
<td>Patanjali Kesh Kanti Shampoo with Rosemary and Tea Tree Oil</td>
</tr>
<tr>
<td>Avalon Organic Tea Tree Shampoo</td>
</tr>
<tr>
<td>Avon Naturals Tea Tree and Mint Anti Dandruff Shampoo</td>
</tr>
<tr>
<td><strong>Facewash</strong></td>
</tr>
<tr>
<td>Ayur Tea Tree Face Wash for Acne-Prone &amp; Oily Skin&quot;</td>
</tr>
<tr>
<td>Oriflame Tea Tree Purifying Wash and Tone Gel</td>
</tr>
<tr>
<td>Jovees Tea Tree Oil Face Wash&quot;</td>
</tr>
<tr>
<td>Avon Purifying - tea tree oil and green tea Face Wash&quot;</td>
</tr>
<tr>
<td>The Body Shop Tea Tree Oil Facial Wash&quot;</td>
</tr>
</tbody>
</table>

5. CONCLUSION

This review clarifies the widespread applications of Tea tree oil (Melaleuca alternifolia) 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.

REFERENCES

33. Tea Tree Skin Clearing Toner | The Body Shop ® [Internet], Cited on 11/11/2013, Available from: www.thebodyshop-usa.com › Shop Ingredients › Tea Tree
34. ALKMENE Teebaum Gesichtscrème 50 ml: Amazon.de: Parfümerie ...[Internet], Cited on 11/11/2013, Available from: www.amazon.de › ... › Tagespflege
38. Best Tea Tree Shampoos Available In India - Our Top 10 | StyleCraze [Internet], Cited on 11/11/2013, Available from: www.stylecraze.com › Articles › Hair › Hair Care Ideas
42. Avon Naturals Tea Tree Oil & Green Tea Purifying Skin Care Review [Internet], Cited on 11/11/2013, Available from: kimpossiblygorgeous.com/.../green-natural-avon-naturals-tea-tree-oil-gre...
43. The Body Shop Tea Tree Oil Facial Wash | Beautylish [Internet], Cited on 11/11/2013, Available from: www.beautylish.com › ... › Cleansers › The Body Shop Cleansers