Over the last few years, a great deal of interest has emerged in natural products with potential medicinal properties. Estimates from the World Health Organization suggest that 65% to 80% of the world’s population uses conventional medicine as the primary form of therapy; however, the use of herbal medicine is the primary form of health care in developing countries and has been increasing in developed countries in recent years.1 Because all of these remedies are available over the counter, it is important for the physician to be informed about the herbal therapies that currently exist. One such plant extract in which health-care providers are showing increased interest is tea-tree oil.

Derived by steam distillation from the leaves of a shrub-like tree (*Melaleuca alternifolia*) indigenous to Australia, tea-tree oil has been used since the early 20th century for a wide variety of bacterial and fungal infections of the skin and mucosa. As with most naturally occurring agents, claims of effectiveness have been only anecdotal; however, several published studies have recently demonstrated tea-tree oil’s antibacterial activity. This study was conducted to determine the activity of tea-tree oil against 58 clinical isolates: *Candida albicans* (n = 10), *Trichophyton rubrum* (n = 8), *Trichophyton mentagrophytes* (n = 9), *Trichophyton tonsurans* (n = 10), *Aspergillus niger* (n = 9), *Penicillium* species (n = 9), *Epidermophyton floccosum* (n = 2), and *Microsporum gypseum* (n = 1). Tea-tree oil showed inhibitory activity against all isolates tested except one strain of *E floccosum*. These *in vitro* results suggest that tea-tree oil may be useful in the treatment of yeast and fungal mucosal and skin infections. (J Am Podiatr Med Assoc 88(10): 489-492, 1998)
While most herbal therapies have been supported by anecdotal evidence only, tea-tree oil has recently been the subject of several in vitro and in vivo studies throughout the world. According to Carson et al., tea-tree oil has a wide spectrum of antimicrobial activity and is relatively nontoxic when applied topically. Various studies have reported tea-tree oil’s antimicrobial activity against Staphylococcus aureus, Propionibacterium acnes, Escherichia coli, Pseudomonas aeruginosa, methicillin-resistant S. aureus, Candida albicans, Malassezia furfur, and various other pathogens. Clinical studies have also been recently documented in the literature concerning the effects of tea-tree oil. Bassett et al. reported that tea-tree oil had a significant effect in ameliorating patients’ acne, with fewer side effects, in comparison with 5% benzoyl peroxide. In 1992, Tong et al. reported that tea-tree oil cream appears to reduce the symptomatology of tinea pedis as effectively as tolnaftate. Walker reported good to excellent results when using the oil against tinea pedis, bromhidrosis, and other inflammatory foot problems. Other clinical investigations have been conducted on the use of tea-tree oil for onychomycosis, furunculosis, trichomonal vaginitis, and oral gingivitis.

Many studies on tea-tree oil’s antibacterial activity have been reported in the literature, but additional studies on its antifungal activities are still needed. The purpose of the present study was to determine the in vitro activity of tea-tree oil (oil of Melaleuca alternifolia) against clinical isolates of C. albicans, various dermatophytes, and molds, using a modified disk diffusion methodology.

Materials and Methods

Melaleuca alternifolia Oil

Tea-tree oil (oil of Melaleuca alternifolia) was obtained from Now Foods, Glendale Heights, Illinois (Lot #14086, Expiration 12/98), for use in this in vitro investigation. This sample fulfilled the criteria of the Australian Standard, with a terpinen-4-ol level of 38.2% and a 1,8 cineole level of 3.5% as determined by gas liquid chromatographic analysis.

Test Organisms

The 58 clinical isolates were identified by standard methods in the Clinical Microbiology Laboratory at Wilmington Hospital in Wilmington, Delaware, and then submitted to the Infectious Disease Laboratory for susceptibility testing. Prior to testing, organisms were subcultured from water stock to Sabouraud’s dextrose agar and then restreaked twice more (molds were restreaked once after subculturing from water stock).

Disk Diffusion Method: Candida albicans

A direct colony suspension method was used to standardize inoculum to match a 0.5 McFarland turbidity standard as described by the National Committee for Clinical Laboratory Standards. Sabouraud’s dextrose agar prepared in-house (4-mm depth) was used for susceptibility testing. After inoculation of the standardized organism suspension to the agar surface, a blank, sterile paper disk was placed in the center. The disk was then inoculated with 20 µl of undiluted tea-tree oil. Plates were taped shut and incubated in air at 30°C for 16 to 18 hours. Zones were read using reflected light and measured to the nearest whole millimeter.

Disk Diffusion Method: Dermatophytes and Molds

The yeast procedure described above was used with the following variations: 1) No disk or Melaleuca alternifolia oil was added to the inoculated plates until after growth was evident at the inoculum size chosen (0.5 McFarland = 1 – 2 × 10⁸ colony-forming units per milliliter); and 2) incubation times varied according to maturity date of the organism.

Results

Tea-tree oil demonstrated inhibitory activity against C. albicans, Trichophyton rubrum, Trichophyton mentagrophytes, Trichophyton tonsurans, Aspergillus niger, Penicillium species, and Microsporum gypseum (Fig. 1). Inhibition was not demonstrated against one test strain of Epidermophyton floccosum. Zones of inhibition and maturity date for each organism are given in Table 1. Control cultures of all yeast, dermatophyte, and mold strains developed normally. The 10 isolates of C. albicans were run in duplicate, and zones were shown to be almost identical to each other.

Discussion

Tea-tree oil is currently experiencing much popularity in the field of herbal medicine. Many products containing this essential oil are now available for personal use. The oil has already been shown to be antibacterial, and the present study supports the anecdotal evidence of its antifungal activity. The usual
Figure 1. Zones of inhibition show significant activity of tea-tree oil (oil of Melaleuca alternifolia) against (A) Candida albicans, (B) Trichophyton rubrum, (C) Trichophyton mentagrophytes, and (D) Aspergillus niger.

Table 1. Zones of Inhibition for 58 Strains of Yeast, Dermatophytes, and Molds versus Tea-Tree Oil

<table>
<thead>
<tr>
<th>Species</th>
<th>Zones of Inhibition (mm)</th>
<th>Maturity</th>
<th>Date (day no.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candida albicans (n = 10)</td>
<td>26</td>
<td>21–35</td>
<td>3</td>
</tr>
<tr>
<td>Duplicate plate (n = 10)</td>
<td>27</td>
<td>23–30</td>
<td>3</td>
</tr>
<tr>
<td>Trichophyton rubrum (n = 8)</td>
<td>47.5</td>
<td>NG–50</td>
<td>12</td>
</tr>
<tr>
<td>Trichophyton mentagrophytes (n = 9)</td>
<td>35.5</td>
<td>NG–49</td>
<td>11</td>
</tr>
<tr>
<td>Trichophyton tonsurans (n = 10)</td>
<td>32.8</td>
<td>NG–40</td>
<td>17</td>
</tr>
<tr>
<td>Epidermophyton floccosum (n = 2)</td>
<td>#1-NG</td>
<td>NG</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>#2-NG</td>
<td>Resistant</td>
<td></td>
</tr>
<tr>
<td>Microsporum gypseum (n = 1)</td>
<td>NG</td>
<td>NG</td>
<td>–</td>
</tr>
<tr>
<td>Aspergillus niger (n = 9)</td>
<td>20</td>
<td>15–30</td>
<td>3</td>
</tr>
<tr>
<td>Penicillium species (n = 9)</td>
<td>23.8</td>
<td>11–42</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: Less than 0.06 mm = resistant.
Abbreviation: NG, no growth visible.

therapeutic concentration is approximately 2% to 10%, but even higher concentrations are commonly used for external treatment. Some minor occurrences of dermal irritation have been reported with the use of higher concentrations of tea-tree oil, but such irritation appears to be rare and requires further investigation.18, 19

The specimens used in this study are some of the more common pathogens responsible for skin ailments such as onychomycosis, candidiasis, tinea pedis, tinea corporis, tinea cruris, tinea capitis, and tinea manus. These results demonstrating the antifungal activity of tea-tree oil may help to inform the physician about its use in the podiatric arena. Additional clinical and laboratory studies are needed to help justify the use of this promising natural product.

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References