Antifungal activity of Five Plant Essential Oils against wood decay fungi isolated from an old house at the Medina of Fez

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Oils from five medicinal plants were screened for their activities against wood rot fungi were isolated from an old house at the historic medina of Fez. The antimycotic activity was investigated by disc diffusion method and minimum inhibitory concentration (MIC) of oils by agar dilution method. The oils of Origanum compactum, Eugenia caryophyllata and Ocimum basilicaum have showed a maximum antimycotic activity against wood fungi as compared to control. In contrast, oil of Thymus vulgaris and Melaleuca alternofolia exhibited moderate activity against these fungi. Furthermore, mixed oils of Origanum compactum and Ocimum basilicum showed maximum activity as compared to control. Altogether, these results support the concept that plant oils may be used as efficient preservatives of wood in the historic monuments at the medina of Fez.

Key words: Essential oil, Antifungal activity, wood decay fungi

INTRODUCTION

Fez is the oldest and greater of Morocco’s imperial cities. UNESCO has designated the entirety of the Fez Medina as a World Monument. In this medina, the wood used in the constructions is mainly the cedar. Decay of the wood of monuments in Fez, caused by many common white and brown rot fungi, has been well characterized in a precedent study (Zyani et al., 2009). The special properties of wood, including its appearance, low density, low thermal expansion and mechanical strength, have led to indoor and outdoor applications for the construction of these monuments. The durability of wood has often been recognized as one of disadvantages in this kind of construction. Find effective methods to prolong resistance have always been the interest of researchers from the timber industry. From the perspective of the environment respect, study of natural constituents found in very durable tree species and understanding their mechanisms are the most appropriate approaches to prolong the life of timber while protecting the environment (Chang et al., 2000).

The protection of wood is predominantly realized by chemicals compounds. These products are based on metals such as copper chromated arsenate (CCA). Since, researchers have focused for developing new methods for preserving wood against fungi, mold and insects (Kartal et al., 2004). The health impacts caused by mold in homes and buildings are a major concern for homeowners, builders and contractors. The health problems caused by mold exposure indoors of homes have caused loss of 2.8 billion dollars in 2002 (Hartwig et al., 2003). Chemical fungicides that are commonly used to control the growth of mold and fungal decay of wood are not suitable for many indoor applications. The searches for natural solutions that are user friendly and showing negligible toxicity to humans are increasingly
The table 1 shows the major components of the five essential oils tested, their major components and the % of components: Origanum compactum, Eugenia caryophyllata, Ocimum basilicum, Melaleuca alternafolia and Thymus vulgaris.
Table 2: Antifungal activity of the five oils of medicinal plants against fungi decay wood

<table>
<thead>
<tr>
<th>Fungi / Plants Oil</th>
<th>T. hyalocarpa</th>
<th>P. commune</th>
<th>P. chrysogenum</th>
<th>P. expansum</th>
<th>C. cladosporioides</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1% (0.01%)</td>
<td>0.1% (0.01%)</td>
<td>0.1%</td>
<td>0.01%</td>
<td>0.1%</td>
</tr>
<tr>
<td>O. basilicum</td>
<td>22±0.5</td>
<td>10±0.5</td>
<td>21±0.5</td>
<td>14±0.5</td>
<td>18±0.5</td>
</tr>
<tr>
<td>M. alternafolia</td>
<td>12±0.5</td>
<td>2±0.5</td>
<td>14±0.5</td>
<td>No Zone</td>
<td>No Zone</td>
</tr>
<tr>
<td>O. compactum</td>
<td>20±0.5</td>
<td>12±0.5</td>
<td>total inhibition</td>
<td>20±0.5</td>
<td>10±0.5</td>
</tr>
<tr>
<td>T. vulgaris</td>
<td>25±0.5</td>
<td>10±0.5</td>
<td>5±0.5</td>
<td>2±0.5</td>
<td>5±0.5</td>
</tr>
<tr>
<td>E. caryophyllata</td>
<td>total inhibition</td>
<td>25±0.5</td>
<td>15±0.5</td>
<td>12±0.5</td>
<td>2±0.5</td>
</tr>
<tr>
<td>Mixed oils</td>
<td>total inhibition</td>
<td>24±0.5</td>
<td>18±0.5</td>
<td>20±0.5</td>
<td>16±0.5</td>
</tr>
<tr>
<td>Paraffin oil</td>
<td>No Zone</td>
<td>No Zone</td>
<td>No Zone</td>
<td>No Zone</td>
<td>No Zone</td>
</tr>
</tbody>
</table>

The table 2 represents the antifungal activity of the five oils of medicinal plants against T. hyalocarpa, P. commune, P. chrysogenum, P. expansum and C. cladosporioides. Two concentrations were used 0.1% and 0.01% for each essential oil. The paraffin oil was used as a negative control. No zone: any inhibition.

Each test was performed five times, and the data averaged (n = 5). Values of inhibition are significantly different at the level of p<0.05 according to Tukey’s Test.

RESULTS

Antifungal activity of Five Plants Essential Oils

The antifungal activities of five plant oils obtained by the disc diffusion method are shown in Table 2. The maximum antifungal activity was shown by Origanum compactum, Eugenia caryophyllata and Ocimum basilicum (p<0.05). The oils of Melaleuca alternafolia and Thymus vulgaris showed low activity against all fungi (p>0.05). Subsequently we have determinate the MIC and IC50 values of these five oils against the fungal mycelium by the agar dilution method. The MIC of these 5 plant oils is shown in Table 3. Origanum compactum and Eugenia caryophyllata had lowest MIC of (0.01%v/v) against Thielavia hyalocarpa and Cladosporium cladosporioides. In addition Ocimum basilicum inhibited Thielavia hyalocarpa at low concentration, but the others fungi had moderate MIC. However Melaleuca alternafolia and Thymus vulgaris failed to inhibit the five fungi at the highest concentration, which was 2% (v/v). Mixed oils had lowest MIC of 0.01% (v/v) against T.hyalocarpa and C.cladosporidies. The lowest minimum inhibitory concentrations were 0.01 % (v/v) of mixed oils against T.hyalocarpa and C.cladosporidies. The effectiveness of O.compactum and E.caryophyllata as an antifungal agent was also reported (Zouhar et al., 2009 and Ezzaoui et al., 2007).

Fungi response fungi to vapor exposure of essential oils

The most effective fungi inhibitor was O.compactum and E.caryophyllata oil vapor; it retarded growth of all seven fungi for at least 20 weeks. O.basilicum inhibited T.hyalocarpa and C.cladosporidies for 20 weeks, and P.commune, P. expansum and P.chrysogenum for 15 weeks. Melaleuca alternafolia vapor retarded T.hyalocarpa and C.cladosporidies for 12 weeks and P.commune, P. expansum and P.chrysogenum for 10 weeks. Thymus vulgaris retarded T. hyalocarpa for 15 weeks and C.cladosporidies 10 weeks but was ineffective against P.commune, P.expansum and P.chrysogenum. These finding suggest that components carvacrol, eugenol, eugenyl acetate linalool, chavicol may play a role in preventing spore germination for 3 essential oils O.compactum, E.caryophyllata and O. basilicum.
**DISCUSSION**

To develop environment-friendly alternatives to synthetic fungicides for the control of wood rot fungi, the interest of essential oils has increased. In this study, we investigated the antifungal activities. For this objective, five essential oils were used as volatile compounds against fungi decay wood. This was done by exposure to vapor phases of the oils. As the results show, the essential oils of *O. compactum* and *E. caryophyllata* are active on all fungus. However *M. alternafolia* and *T. vulgaris* are active only against one fungus. The essential oil of *O. compactum* and *E. caryophyllata* showed the broadest antifungal spectrum in this study. The inhibitory effect against wood decay fungi and the antibacterial activities of *O. compactum* and *E. caryophyllata* oil were reported previously by several studies (Eszaouia et al., 2007; Hoffman et al., 2004; Hoffman, 1987; Mau et al., 2001).

In this study, *O. basilicum* oil shows the maximum antifungal spectrum as *O. compactum* oil. Our data are in agreement with Oyewale et al., (1988) who reported that the oil of *O. basilicum* possessed a wide spectrum of fungicidal activity. Beside it insecticidal and nematicidal activities, antifungal activity of *O. basilicum* against several species of *Aspergillus* and *Penicillium* was also reported (Isman, 2000; Pandey et al., 2000; Yang and Clausen, 2007).

*T. vulgaris* oil inhibits mycelial growth of two wood decay fungi such as *T. hyalocarpa* and *C. cladosporioides*, but was not active on *P. commune*, *P. expansum* and *P. chrysogenum*. The essential oil of *T. vulgaris* inhibits various fungi involved in food spoilage; mycotoxin producing and postharvest pathogenic fungi (Njuefack et al., 2004; Reddy et al., 1997) reported that *T. vulgaris* oils controlled decay of strawberry fruits caused by *Botrytis*.

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**Table3:** Minimum inhibitory concentration (MIC) and (IC50 values) of selected essential oils (%v/v) against fungi decay wood using agar diffusion method

<table>
<thead>
<tr>
<th>Plant oils</th>
<th><em>T. hyalocarpa</em> IC 50 / MIC</th>
<th><em>P. commune</em> IC 50 / MIC</th>
<th><em>P. chrysogenum</em> IC 50 / MIC</th>
<th><em>P. expansum</em> IC 50 / MIC</th>
<th><em>C. cladosporioides</em> IC 50 / MIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ocimum basilicum</em></td>
<td>0.3 / 0.4</td>
<td>0.8 / 1.5</td>
<td>0.6 / 1.4</td>
<td>1 / 1.4</td>
<td>0.6 / 1.5</td>
</tr>
<tr>
<td><em>Melaleuca alternafolia</em></td>
<td>0.3 / 0.4</td>
<td>1.2 / 2</td>
<td>1 / 1.4</td>
<td>nd / &gt;2</td>
<td>0.8 / 1.6</td>
</tr>
<tr>
<td><em>Origanum compactum</em></td>
<td>nd / 0.01</td>
<td>0.2 / 0.4</td>
<td>0.1 / 0.2</td>
<td>0.08 / 0.1</td>
<td>nd / 0.01</td>
</tr>
<tr>
<td><em>Thymus vulgaris</em></td>
<td>0.08 / 0.1</td>
<td>1.5 / 2</td>
<td>nd / &gt;2</td>
<td>nd / &gt;2</td>
<td>0.5 / 1</td>
</tr>
<tr>
<td><em>Eugenia caryophyllata</em></td>
<td>nd / 0.01</td>
<td>0.6 / 0.4</td>
<td>0.3 / 0.4</td>
<td>0.2 / 0.4</td>
<td>nd / 0.01</td>
</tr>
<tr>
<td>Mixed oils ( <em>O. basilicum</em> and <em>Origanum compactum</em>)</td>
<td>nd / 0.01</td>
<td>0.4 / 1</td>
<td>0.2 / 0.4</td>
<td>0.2 / 0.5</td>
<td>0.05 / 0.1</td>
</tr>
</tbody>
</table>

In Table 3 Minimum inhibitory concentration and IC50 values (the concentration that inhibited 50% of the mycelium of fungi growth) was determined for each oil against different fungi causing wood decay using agar diffusion method. Each test was performed three times, and the data averaged (n = 3). Values of MIC are significantly different at the level of *p*<0.05 according to the Tukey’s Test.
REFERENCES


