Antifungal Activity of Jatropha curcas Oil Against Some Seed-borne Fungi

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Abstract: Various parts of the Jatropha curcas plant are of medicinal value, its wood and fruit can be used for numerous purposes including fuel. In the present study the effectiveness of Jatropha curcas oil on inactivation of some mycoflora were determined. As a measure of testing the antimicrobial property of Jatropha curcas oil were subjected against six selected fungi viz. Alternaria alternata, Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Fusarium chlamydosporum and Penicillium glabrum. Poisoned food technique was used to evaluate the antifungal effect of J. curcas oil. Two different concentrations of Jatropha oil i.e., 100 µL and 500 µL were mixed with potato dextrose agar (PDA) medium in Petri plates. Maximum radial growth was shown by control of Aspergillus flavus, Aspergillus fumigatus and Aspergillus niger i.e., 90 mm (full growth on petri plate) followed by the control of Alternaria alternata i.e., 77.3 mm and minimum growth was shown by Penicillium glabrum i.e., 21 mm followed by Aspergillus niger i.e., 33 mm at 500 µL concentration of Jatropha oil. Maximum percent inhibition was shown by Penicillium glabrum i.e., 82.96% followed by Aspergillus niger i.e., 63.33% at 500 µL concentration of Jatropha oil and minimum percent inhibition was shown by Fusarium chlamydosporum i.e., 31.59% at 100 µL concentration of Jatropha oil. From this experiment it was concluded that Jatropha oil has promising antifungal effect on Penicillium glabrum and Aspergillus niger.

Keywords: Antifungal, biodiesel, physic nut, poisoned food technique, seed-borne fungi, Aspergillus, Penicillium

Introduction

The oil plant Jatropha curcas L. (physic nut) which belongs to the family Euphorbiaceae is a multipurpose drought resistance, perennial plant. Jatropha seeds are a good source of oil which can be used as a diesel substitute. It is a small tree that grows originally in areas near the equator (Srivastava et al., 2011). Jatropha curcas puts among the world oil seed crops that contains high (30-40%) amount of oil (Krishnamurthy, 2005).

High quality biodiesel is produce from Jatropha oil (Mandpe et al., 2005). Compared to conventional diesel, biodiesel has the advantage of being a renewable indigenous fuel, the use of which has positive consequences for the environment and rural socio-economy. In tropical countries, environmentally and socially sustainable production of Jatropha oil can take place (Francis et al., 2005).

The Jatropha seeds also contain antinutritional factors including trypsin inhibitor, lectin, saponin and phytic acid and toxic compounds called phorbol esters including high protein content (Martinez-Herrera et al., 2006). It has been known that all parts of Jatropha curcas can be used for a wide range of purposes. Various parts of J. curcas extracts have shown molluscicidal, insecticidal and fungicidal properties (Liu et al., 1997; Meshram et al., 1996; Nwosu and Okafor, 1995; Rug and Ruppel, 2000; Solosloy and Solosloy, 1997). Jatropha curcas seed extracts were found to inhibit the mycelial growth of the causal organism of anthracnose disease in bananas i.e., Colletotrichum musae (Thangavelu et al., 2004). J. curcas have played a major role in the treatment of various diseases including bacterial and fungal infection. The extracts of many Jatropha species including J. curcas displayed potent cytotoxic, anti-tumor and anti-microbial activities in different assays (Ayelaagbe et al., 2007).

The objective of this study was to analyze the antifungal effect Jatropha curcas oil on some selected fungi.

Materials and Methods

Estimation of antifungal activity of Jatropha oil: Effect of different concentrations of Jatropha oil on six selected dominant fungi viz., Alternaria alternata,
Aspergillus flavius, Aspergillus fumigatus, Aspergillus niger, Fusarium chlamydosporum and Penicillium glabrum were estimated with help of poisoned food technique (Nene and Thapliyal, 2000). The J. curcas seeds were powdered and extracted thoroughly with light petroleum ether (60-80°C) in a Soxhelt extractor for 24-48 h in each case. Once more the remaining powder was extracted to collect all oil in the seeds. Combined petroleum ether was dried over anhydrous sodium sulphate and solvent was removed in vacuum at 40°C by using rotary evaporator to recover oil (Link, 1975). Two different concentrations of Jatropha oil, 100 μL and 500 μL were taken to determine the antifungal activity. Jatropha oil was mixed with Potato Dextrose Agar (PDA) medium in Petri plates. Put 3 mm disc of all selected fungi on each Petri plate aseptically when the media got solidified. Control having no any concentration of Jatropha oil. After inoculation all the Petri plates were kept in incubator at 25±2°C under 12 h alternating cycles of light and darkness.

**Calculation of percent inhibition:** The percent inhibition of fungal growth was calculated by using the following formula (Vincent, 1947):

\[ I = \frac{C - T}{C} \times 100 \]

where, C is Control and T is Treatment.

**RESULTS**

Data presented in Table 1 and 2 show the antifungal activity of Jatropha curcas L. seed oil against six

Table 1 revealed that after 24 h, maximum radial growth was shown by control of Aspergillus fumigatus i.e., 19 mm followed by the control of Aspergillus flavius i.e., 17 mm whereas the minimum radial growth was shown by Aspergillus fumigatus and Fusarium chlamydosporum i.e., 5 mm followed by Aspergillus flavius and Penicillium glabrum i.e., 6 mm at 500 μL concentration of Jatropha oil. After 48 h, maximum radial growth was shown by control of Alternaria alternata i.e., 27.6 mm followed by the control of Aspergillus flavius i.e., 27.3 mm whereas where the minimum radial growth was shown by Aspergillus fumigatus and Penicillium glabrum i.e., 13 mm followed by Fusarium chlamydosporum i.e., 16 mm at 500 μL concentration of Jatropha oil. After 72 h, maximum radial growth was shown by control of Aspergillus flavius i.e., 73.3 mm followed by the control of Aspergillus niger i.e., 73 mm whereas where the minimum radial growth was shown by Penicillium glabrum i.e., 17 mm followed by Aspergillus fumigatus i.e., 24 mm at 500 μL concentration of Jatropha oil. After 96 h, maximum radial growth was shown by control of Aspergillus flavius, Aspergillus fumigatus and Aspergillus niger i.e., 90 mm (full growth on petri plate) followed by the control of Alternaria alternata i.e., 77.3 mm and minimum growth was shown by Penicillium glabrum i.e., 21 mm followed by Aspergillus niger i.e., 33 mm at 500 μL concentration of Jatropha oil.

Data presented in Table 2 show the percent inhibition of the selected dominant seed mycoflora of

<table>
<thead>
<tr>
<th>Dominant fungi</th>
<th>24 h</th>
<th>48 h</th>
<th>72 h</th>
<th>96 h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>100 (μL)</td>
<td>500 (μL)</td>
<td>Control</td>
</tr>
<tr>
<td>Alternaria alternata</td>
<td>15.3</td>
<td>10.0</td>
<td>10.0</td>
<td>27.6</td>
</tr>
<tr>
<td>Aspergillus flavius</td>
<td>17.0</td>
<td>08.0</td>
<td>06.0</td>
<td>27.3</td>
</tr>
<tr>
<td>Aspergillus fumigatus</td>
<td>19.0</td>
<td>06.0</td>
<td>05.0</td>
<td>22.3</td>
</tr>
<tr>
<td>Aspergillus niger</td>
<td>13.0</td>
<td>10.0</td>
<td>07.0</td>
<td>27.0</td>
</tr>
<tr>
<td>Fusarium chlamydosporum</td>
<td>07.0</td>
<td>06.0</td>
<td>05.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Penicillium glabrum</td>
<td>09.0</td>
<td>08.0</td>
<td>06.0</td>
<td>20.3</td>
</tr>
</tbody>
</table>

Table 2: Effect of different concentrations of Jatropha oil on inhibition of dominant fungi

<table>
<thead>
<tr>
<th>Dominant fungi</th>
<th>Inhibition (%)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>24 h</td>
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<tr>
<td></td>
<td>100 (μL)</td>
</tr>
<tr>
<td>Alternaria alternata</td>
<td>34.64</td>
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<tr>
<td>Aspergillus flavius</td>
<td>52.94</td>
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<tr>
<td>Aspergillus fumigatus</td>
<td>68.42</td>
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<tr>
<td>Aspergillus niger</td>
<td>23.08</td>
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<tr>
<td>Fusarium chlamydosporum</td>
<td>14.29</td>
</tr>
<tr>
<td>Penicillium glabrum</td>
<td>11.11</td>
</tr>
</tbody>
</table>
Jatropha curcas L. due to Jatropha oil. After 24 h, maximum percent inhibition was shown by Aspergillus fumigatus i.e., 73.68% followed by Aspergillus flavus i.e., 64.71% at 500 µL concentration of Jatropha oil and minimum percent inhibition was shown by Penicillium glabrum i.e., 11.11% at 100 µL concentration of Jatropha oil. After 48 h, maximum percent inhibition was shown by Aspergillus fumigatus i.e., 41.70% followed by Aspergillus flavus i.e., 37.73% at 500 µL concentration of Jatropha oil and minimum percent inhibition was shown by Aspergillus niger i.e., 3.70% at 100 µL concentration of Jatropha oil. No percent inhibition was shown by Fusarium chlamydosporum at 100 µL concentration of Jatropha oil. After 72 h, maximum percent inhibition was shown by Aspergillus fumigatus i.e., 64.55% followed by Aspergillus flavus i.e., 57.71% at 500 µL concentration of Jatropha oil and minimum percent inhibition was shown by Fusarium chlamydosporum i.e., 26.83% at 100 µL concentration of Jatropha oil. After 96 h, maximum percent inhibition was shown by Penicillium glabrum i.e., 82.96% followed by Aspergillus niger i.e., 63.33% at 500 µL concentration of Jatropha oil and minimum percent inhibition was shown by Fusarium chlamydosporum i.e., 31.59% at 100 µL concentration of Jatropha oil.

DISCUSSION

From the above results it was concluded that Jatropha oil has promising antifungal effect on Penicillium glabrum and Aspergillus niger. Similarly, Makun et al. (2011) observed in vitro and in vivo investigation of the antifungal properties of Jatropha curcas and Ricinus communis seed extracts against the mycelia growth and rot development of yam caused by Fusarium verticillioides and Aspergillus flavus. The result showed that castor oil seed crude extract lowers mycelia growth of F. verticillioides significantly at (p<0.05) compared to other treatments under both in vitro and in vivo conditions, it also lowered the rot index in yam. Similarly, castor seed oil (crude extracts) had the lowest mycelial growth on A. flavus in vitro while in vivo, J. curcas crude extract and deoiled castor seed oil (crude extract) significantly (p<0.05) reduced rot depth of yam compared with other treatments. The findings indicate that J. curcas and R. communis seeds have promising potentials in the management of plant fungal diseases.

There is no any plant or their product which cannot show any antimicrobial or medicinal properties in this support (Hammer et al., 1999), investigated the 52 plant oils and extracts for their antimicrobial activity against Acinetobacter baumannii, Aeromonas veronii, Candida albicans, Enterococcus faecalis, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Salmonella enterica subsp. enterica, Serratia marcescens and Staphylococcus aureus and 20 of the plant oils and extracts against C. albicans, S. aureus and E. coli by using an agar dilution method and a broth micro-dilution method, respectively. From this study, they reported that plant essential oils and extracts play a crucial role in the field of pharmaceuticals and preservatives.

From the results it was proved that at 500 µL concentration of Jatropha curcas oil the growth of fungi were more inhibited than at 100 µL concentration. This was already proved by Jaglan (2008) that the antifungal activity of Jatropha curcas oil decreased with dilution. Diameter of zone of inhibition was more in case of neat than that of zone at 1:2 and 1:4 dilutions. The antifungal activity of Jatropha oil was found to be more against Aspergillus sp., the diameter of zone of inhibition at neat is 2.25 mm and is decreased with dilution at 1:2 and 1:4 (1.3 and 1.1 mm, respectively). The antifungal activity of Jatropha oil against Penicillium sp. was also more at neat as compared to zones at dilutions 1:2 and 1:4. The diameter of zone of inhibition at neat is 1.8 mm. The diameter zone of inhibition is decreases with dilutions at 1:2 and 1:4 (1.4 and 0.9 mm, respectively).

Microorganisms responsible for the sexually transmitted infection were inhibited by some secondary metabolites extracted from the roots of J. curcas. Phytochemicals are known to be biologically active and therefore aid the antibacterial property of J. curcas (Aiyelagbe et al., 2007). J. curcas seed oil showed antimicrobial activity against E. coli and Streptococcus pyogenes without containing tannins and phenolics-suggesting that the oil cannot be used as a disinfectant, but can find usefulness as a chemotherapeutic agent (Willey et al., 2008). Similarly, Ejeleolu et al. (2010) were also reported that E. coli O157:H7, and Streptococcus pyogenes are killed by both the Jatropha curcas and Mucuna solan seeds-oil, respectively. An inhibition zone of 15.0 mm was recorded for J. curcas seed oil while that of Mucuna solan was 10.0 mm. This showed that Jatropha curcas seed oil was more effective than the Mucuna solan seed soil against E. coli O157:H7.

From the above results and discussion it was concluded that Jatropha curcas oil has effective antifungal properties against seed-borne fungi. The fungi
mainly used in this study was human pathogenic also, at that point of view *Jatropha curcas* oil shows their medicinal property.

**REFERENCES**


