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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*.

Key words: 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; Solsoloy and Solsoloy, 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 (Aiyelaagbe *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*,

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Aspergillus flavus, *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 the powdered seed was extracted to collect all oil in the seeds. Combined petroleum ether extract 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 dominant seed mycoflora viz., *Alternaria alternata*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus niger*, *Fusarium chlamydosporum* and *Penicillium glabrum*.

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 flavus* i.e., 17 mm where as the minimum radial growth was shown by *Aspergillus fumigatus* and *Fusarium chlamydosporum* i.e., 5 mm followed by *Aspergillus flavus* 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 flavus* i.e., 27.3 mm where as 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 flavus* i.e., 73.3 mm followed by the control of *Aspergillus niger i.e.,* 73 mm where as 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 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.

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

Table 1: Effect of different concentrations of *Jatropha* oil on radial growth of dominant fungi

	Radial growth (mm)											
	24 h			48 h			72 h			96 h		
Dominant fungi	Control	100 (μL)	500 (μL)	Control	100 (μL)	500 (μL)	Control	100 (μL)	500 (μL)	Control	100 (μL)	500 (μL)
Alternaria alternata	15.3	10.0	10.0	27.6	19.0	19.0	45.0	28.0	29.0	77.3	43.0	40.0
Aspergillus flavus	17.0	08.0	06.0	27.3	21.0	17.0	73.3	34.0	31.0	90.0	51.0	44.0
Aspergillus fumigatus	19.0	06.0	05.0	22.3	16.0	13.0	67.7	28.0	24.0	90.0	45.0	39.0
Aspergillus niger	13.0	10.0	07.0	27.0	26.0	23.0	73.0	33.0	35.0	90.0	45.0	33.0
Fusarium chlamydosporum	07.0	06.0	05.0	20.0	20.0	16.0	41.0	34.0	30.0	68.7	47.0	43.0
Penicillium glabrum	09.0	08.0	06.0	20.3	15.0	13.0	31.3	19.0	17.0	56.7	21.0	21.0

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

	Inhibition (%)							
	24 h		48 h		72 h		96 h	
Dominant fungi	100 (μL)	500 (μL)	100 (μL)	500 (μL)	100 (μL)	500 (μL)	100 (μL)	500 (μL)
Alternaria alternata	34.64	34.64	35.16	35.16	37.78	35.56	44.37	48.25
Aspergillus flavus	52.94	64.71	23.08	37.73	53.62	57.71	43.33	51.11
Aspergillus fumigatus	68.42	73.68	28.25	41.70	58.64	64.55	50.00	56.67
Aspergillus niger	23.08	46.15	03.70	14.81	54.80	52.05	50.00	63.33
Fusarium chlamydosporum	14.29	28.57	-	20.00	17.07	26.83	31.59	37.41
Penicillium glabrum	11.11	33.33	26.11	35.96	39.30	45.69	62.96	82.96

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 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 anti fungal 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* (Aiyelaagbe *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, Ejelonu *et al.* (2010) were also reported that *E. coli* O_{157}:H_7 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* O_{157}:H_7.

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.

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