ANTIFUNGAL POTENTIAL OF PLANTS EXTRACT AGAINST THE FUNGAL PATHOGENS IN CUCUMBER AND BITTER GOURD (CUCURBITACEAE)

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AUTHORS’ CONTRIBUTIONS
This work was carried out in collaboration between both authors. Author RM designed the study, carried out all the work, wrote the protocol and managed the literature searches. Author MLMKA performed the statistical analysis, managed the analyses of the study and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

The fungicidal activity of five aqueous plant extracts from Azadiracta indica, Eichhornia crassipes, Calatropis procera, Parthinium hysterophorous and Lanta camara was assessed for their antifungal efficacy on the phytopathogenic fungi of Cucumis sativus (Cucumber) and Monardica charantia (Bitter Gourd), Corynespora cassicola and Cercospera citrullina, causative agents of these plants. Three of the five plant extracts were effective against these phytopathogenic fungi. Parthinium hysterophorous, Azadiracta indica and Calatropis procera, extracts were highly active and showed fungicidal activities against phytopathogenic fungi with a minimum concentration (100%). In contrast, Lanta camara extract showed moderate antifungal activity, while Eichhornia crassipes was not effective against phytopathogenic fungi. Therefore the present study was aimed to investigate the fungicidal properties of medicinal plants. These effective plant extracts can contribute to the development of potentially effective and environmentally safe alternative fungicides to control the damping of phytopathogenic fungi in cucumber and bitter gourd.

Keywords: Medicinal plants; Cucumis sativus; Monardica charantia; Corynespora cassicola; Cercospera citrullina; phytopathogenic fungi.

1. INTRODUCTION

Plant diseases caused by pathogenic fungi are the most important factors limiting agricultural production worldwide, particularly in developing countries [1]. In addition to their ability to cause yield losses and food degradation, numerous fungi pose a very serious risk to consumers due to the result of hazardous secondary metabolites [2]. Most efforts to control plant diseases over the last few years have been focused on effective eradication or prevention through the development of synthetic chemical fungicides [3]. Furthermore, because increasing numbers of fungal diseases in humans, animals and plants are caused by pathogens that become more resistant to drugs currently available, it is important to identify and develop safe, effective and environmentally friendly new alternative fungicides [4,5].

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Natural products or plant extracts have the potential to be used as leads for the synthesis of new agrochemicals or directly as fungicides which have inspired biochemists to develop new bioassays capable of detecting other, structurally simpler compounds with similar modes of action [6]. Since synthetic fungicides are toxic to plants and have the potential to enter the food chain leading to bioaccumulation, the focus must be on developing eco-friendly and effective methods for controlling plant diseases, and use of medicinal plants is one such approach [7]. In comparison to synthetic pesticides, plant metabolites and plant-based pesticides may be a better option, with reduced environmental effect and safer [8]. Active ingredients in medicinal plants have been attempted to replace synthetic fungicides in the management of plant diseases in the organic farming system. Plant extracts could have unique antimicrobial properties with a holistic mode of action. Plant extracts and their components such as alkaloids, terpenoids, glycosides and phenolic acids have been reported in the literature to have antimicrobial activity [9].

Therefore, this investigation was conducted to detect the effect of crude aqueous extracts on two climbers to determine their antifungal potency in vitro against important phytopathogenic fungi. It is an approach to identify antifungal elements in natural sources that can be used to control diseases of the leaves of cucumber and bitter gourd.

2. MATERIALS AND METHODS

2.1 Plant Materials

Climber plants such as Cucumis sativus (Cucumber) and Monardica charantia (Bitter Gourd) were harvested for a period of six months to study the antifungal activity of plant extracts. Five widely available plants from different families were collected fresh from the Rewa District, Madhya Pradesh, India during the summer season in 2014-2015. The taxonomic identification of the plant materials was confirmed by Dr. Rajshree Pandey, School of Environmental Biology, A. P. S. University. Voucher specimens of all plants studied were deposited in the respective herbaria of the Research Department of Environmental Biology Laboratory of A. P. S. University.

2.2 Preparation of Extracts

Fresh plant parts of Azadiracta indica, Eichhornia crassipes, Calatropis procera, Parthinium hysterophorus and Lanta camara were collected and washed thoroughly with sterile distilled water and allowed to dry at room temperature. The dried materials were ground and extracted separately with sterile distilled water. The extracts were filtered through double-layered muslin cloth and centrifuged at 10,000 × g for 30 min. The supernatants of aqueous extracts were sterilized by passing through a Millipore filter (0.2 µm). All extracts were stored at 4°C and used for bioassay.

2.3 Preparation of Standard Solution

From the above extract (100, 75, 50, 25 and 10%) concentrations were prepared and kept in a sprayed bottle for irrigation on plants.

3. RESULTS AND DISCUSSION

The present study tested the antifungal activity of the crude extracts and their respective dilutions of medicinal plants belonging to five families against Cucumis sativus (cucumber) and Monardica charantia (bitter gourd). These medicinal plants have been selected on the basis of either traditional use, suggesting antimicrobial activity, or previous studies showing antifungal properties using different types of extracts [10,11,12].

Among these, three plant extracts at 1 mg / ml were effective in suppressing the mycelial growth of fungi. The leaf extract of Parthinium hysterophorus showed the highest activity (88%), followed by Calatropis procera (81%), Azadiracta indica (75%), Eichhornia crassipes (62%) and Lanta camara (41%) against the cucumber plant. While in bitter gourd, the highest activity was found in Parthinium hysterophorus (85%), Azadiracta indica (76%), Calatropis procera (65%), Lanta camara (55%) and Eichhornia crassipes (33%). Similar studies where carried out by other researchers showed that the antimicrobial properties of Azadirachta indica leaves, which showed high antifungal activity against Pestalotiopsis theae. and Botryodiplodia theobromae, are well established [13]. Literature studies on other plants with more than 90% inhibition of spore germination revealed that the antimicrobial property of Cassia tora, Dryopteris filixma and Psidium guajava had been previously reported. [14,15,16]. Datura metal leaf extracts also showed high antifungal efficacy against all tested pathogens.

In a field study, [17] observed that the aqueous extracts of the leaves sprayed 8 days after planting protect the chili seedlings of Colletotrichum capsici. (Sydow) Butler and Bisby up to 35 days after planting. Curcuma longa also showed substantial activity that is in agreement with findings reported in literature [18]. A variation on fungitoxicity of the
concerned plant extracts against phytopathogenic fungi may be attributed to significant differences in their constituents and variability in fungal species itself [19,20].

The comparison of the inhibition of the growth of crude extracts and their respective dilutions shows a strong dependent effect on the concentrations of extract. In general, the antifungal activity of extract dilutions is lower compared to crude extracts. These results revealed that the antifungal activity of the crude extracts was improved with the increase in the concentration of the extracts, in fact, the inhibitory activity of the extracts depended on the concentration. This finding is in agreement with the report by [21], who also observed that higher concentrations of antimicrobial substances exhibited greater growth inhibition.

Furthermore, the antimicrobial activity of plant extracts may not be due to the action of a single active compound, but to the synergistic effect of several compounds that are in a small proportion in a plant [22]. Our findings are compatible with [23], who proposed that the solvent's chemical properties, the procedure used during the extraction phase and different structural and compositional features of the natural products result in a distinct behavior of each substance solvent network. Differences in polarity between different solvents were reported to account for the differences in solubility of active plant properties, thus variations in the degree of activity.

The present study indicates that the use of plant extracts as biocontrol agents has been found to be effective in controlling cucumber and bitter gourd fungal diseases as well as Parthenium hysterophorous, Azadiracta indica, Calatropis procera extracts may be a desirable option for the use of natural product to control phytopathogenic fungi that resist chemical fungicide. The results obtained from this work have shown that the extracts of selected plants have antifungal effects against cucumber and bitter gourd plants.

4. CONCLUSION

Further studies are needed to determine the chemical identity of the bioactive compounds responsible for the observed antifungal activity. Plant-based fungicides can be a source of new alternative active compounds, in particular with antifungal activity. The high proportion of active extracts in the analyzed species, selected according to the available ethnobotanical data, corroborates the validity of this approach for the selection of plant species in search of a specific activity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES