

Effect of Botanicals Extracts on Phytopathogenic Fungi

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Abstract: Phytopathogenic fungi are important causes of crop diseases and can substantially reduce plant growth, yield and quality. Although synthetic fungicides remain important tools for disease management, their repeated use has raised concerns related to environmental contamination, residues, resistance development and effects on non-target organisms. Plant-derived extracts and their bioactive compounds have therefore attracted considerable attention as potential components of sustainable disease management. The present review examines the antifungal potential of selected plant extracts against phytopathogenic fungi, with particular emphasis on neem (*Azadirachta indica*), garlic (*Allium sativum*), ginger (*Zingiber officinale*), cumin (*Cuminum cyminum*) and other botanicals. In present studies indicate that plant extracts can inhibit fungal mycelial growth, spore germination and other stages of fungal development, although their effectiveness depends on plant species, plant part, extraction solvent, concentration and target pathogen. Neem extracts, for example, have demonstrated inhibitory effects against *Alternaria solani*, *Fusarium oxysporum*, *Rhizoctonia solani* and *Sclerotinia sclerotiorum*. Plant secondary metabolites such as phenolics, flavonoids, terpenoids, alkaloids, sulfur-containing compounds and essential-oil constituents are considered important contributors to antifungal activity. Plant extracts may therefore provide useful alternatives or complements to conventional fungicides, particularly within integrated disease-management systems. However, standardization, formulation, stability, phytotoxicity, field efficacy and regulatory requirements remain important challenges.

Keywords: Plant Extracts, Phytopathogenic Fungi, Botanical Fungicides, Antifungal Activity, Neem, Garlic, Plant Pathology, Sustainable Agriculture.

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I. INTRODUCTION

Plant diseases caused by fungi are among the important biological constraints to agricultural production. Phytopathogenic fungi can infect roots, stems, leaves, flowers, fruits and seeds, resulting in symptoms such as damping-off, wilting, leaf spots, blights, rots, anthracnose and powdery mildew. Such diseases may reduce both crop productivity and the quality of harvested products. Synthetic fungicides have traditionally been used to suppress fungal diseases. However, concerns associated with excessive and repeated application have encouraged researchers to investigate alternative approaches. These concerns include environmental contamination, residues, effects on beneficial organisms and the development of fungicide resistance. These plant extracts are safe, eco friendly, easily biodegradable and cheap as they produce secondary metabolites which perform defensive role in plant and protect plant from invaders. These medicinal plants needs to be investigated in terms of antimicrobial and biochemical properties for better understanding of their properties, safety and efficiency (Bajwa et al., 2007). Reviews of botanical disease-management research have consequently identified

plant-derived products as promising components of sustainable crop protection. Plants produce a large diversity of secondary metabolites, including phenolic compounds, flavonoids, terpenoids, alkaloids, tannins and sulfur-containing compounds. Some of these substances possess antimicrobial properties and can interfere with fungal growth and development. Plant extracts may contain several bioactive compounds simultaneously, potentially providing multiple modes of action.

II. MATERIALS AND METHODS

➤ Survey and Collection of Plant Samples:

Healthy plant samples such as fresh leaves, bulbs, seeds, rhizomes or bark is collected and authenticated of neem (*Azadirachta indica*), garlic (*Allium sativum*), ginger (*Zingiber officinale*), cumin (*Cuminum cyminum*) were collected from four different locations. The collected plant parts were brought to the laboratory in sterile zip lock polythene bags for further studies.

➤ Processing of Plant Samples

The collected samples (leaves and rhizome) were washed thoroughly 2-3 times with running water and once with sterile distilled water to remove the adhering soil and other impurities. The cleaned plant part material were air dried on sterile blotter under shade and blended to form a fine powder and stored in airtight containers for further analysis (Salvamohan et al., 2012).

• Preparation of Plant Extract Preparation of Leaf Extract:

Methanolic and aqueous extracts of all the three medicinal plants were prepared by dissolving 10 gm of fine powder of each medicinal plant separately in 50 ml of methanol and water respectively. Extracts were kept in orbital shaker for 48 hours. Then the extracts were filtered and dried in hot air oven at 40°C. The extract than stored under refrigeration at 4°C for further studies (Salvamohan et al., 2012).

• Preparation of Rhizome Extract:

Fresh Curcuma longa rhizome washed with distilled water to remove soil and other impurities, cut into small pieces of ¼ inches size and air dried for 2 days. The dried sample was again dried in hot air oven at 50°C for 24 h, then grounded into powder and pass through sieve with nominal mesh size of 2mm diameter (Harit et al., 2013). Methanolic and aqueous extract of Curcuma longa (rhizome) was prepared.

• Preparation of Fungal Culture:

A selected phytopathogenic fungus is cultured using an appropriate laboratory medium under controlled conditions.

• Antifungal Assay:

The antifungal activity of the extract can be evaluated using an appropriate validated laboratory assay, such as a diffusion or poisoned-food-type assay. Untreated controls should be included for comparison.

• Measurement:

Fungal growth is measured and compared between treated and untreated cultures.

A commonly used calculation for percentage inhibition of mycelial growth is:

$$\text{Percentage inhibition} = [(C - T) / C] \times 100$$

Where:

C = growth of fungus in the untreated control

T = growth of fungus in the treatment

➤ Statistical Analysis:

Replicated observations should be statistically analyzed using an appropriate statistical method. Mean values, variation and significance should be reported rather than relying on a single observation.

III. RESULTS

From present investigation it is clear that plant extracts can inhibit a variety of phytopathogenic fungi, although the degree of inhibition varies considerably.

Table 1 Plant Extracts

Plant	Plant part commonly investigated	Example target fungi
<i>Azadirachta indica</i>	Leaves, seeds	<i>F. oxysporum</i> , <i>R. solani</i> , <i>A. solani</i> , <i>S. sclerotiorum</i>
<i>Allium sativum</i>	Bulb	<i>Aspergillus spp.</i> , powdery mildew fungi and other pathogens
<i>Zingiber officinale</i>	Rhizome	<i>Macrophomina phaseolina</i> and other fungi
<i>Cuminum cyminum</i>	Seeds	<i>Macrophomina phaseolina</i>

In present investigation it indicate that antifungal activity frequently increases with extract concentration, although the response is pathogen- and extract-dependent. Neem seed and leaf extracts, for example, have demonstrated inhibitory activity against several major phytopathogenic fungi.

IV. DISCUSSION

The reviewed evidence supports the potential use of plant extracts as sources of antifungal substances. Neem and garlic are particularly well studied, while numerous other aromatic and medicinal plants have also demonstrated activity. One important advantage of plant extracts is their chemical complexity. A crude extract can contain several compounds with different biological targets. This characteristic may reduce the likelihood that a pathogen will adapt as readily as it might to a single-site chemical, although resistance cannot be assumed to be impossible. The activity of botanical extracts is strongly affected by extraction procedures. The same plant may produce extracts with

substantially different antifungal activity depending on whether water, alcohol or another solvent is used.

Recent reviews emphasize that although botanical fungicides have significant potential, wider adoption is limited by challenges including standardization, formulation, rapid degradation, regulation and consistent field performance.

V. CONCLUSION

Plant extracts represent a promising source of biologically active substances for the management of phytopathogenic fungi. Research on neem, garlic, ginger, cumin and other botanicals demonstrates that plant-derived preparations can inhibit important fungal pathogens under laboratory conditions. Their activity is associated with diverse secondary metabolites, including phenolics, flavonoids, terpenoids, alkaloids, tannins and sulfur-containing compounds.

However, the effectiveness of plant extracts depends strongly on extraction procedure, concentration, plant material and target pathogen.

Overall, plant extracts have significant potential as components of environmentally oriented and integrated plant disease management. Continued research combining plant pathology, phytochemistry, microbiology, formulation science and agronomy will be necessary to convert promising laboratory observations into reliable agricultural products.

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