IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

Antifungal Activity of Cinnamon Oil on *Corynespora cassicola*: A Comprehensive Study

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Abstract

Corynespora cassicola is a common fungal pathogen that affects various crops, leading to substantial economic losses in agriculture. The search for effective, safe, and environmentally friendly antifungal agents has intensified in recent years. This research paper investigates the antifungal activity of cinnamon oil against *Corynespora* isolated from watermelon seeds by agar plate method and explores its potential as a natural alternative to synthetic fungicides. The study involved in vitro experiment viz., Poisoned Food Technique to evaluate antifungal activity of different concentrations of cinnamon oil viz., 20%, 40%, 60%, 80% and 100% against *Corynespora*. The findings suggest that cinnamon oil exhibits potent antifungal properties, making it a promising candidate for controlling *Corynespora* and potentially other fungal pathogens in agriculture.

Keywords:

Antifungal activity, cinnamon oil, *Corynespora*, minimum inhibitory concentration (MIC), minimum fungicidal concentration (MFC), mechanism of action, disease management.

Introduction

Corynespora cassiicola is a plant pathogen that poses a significant threat to a wide range of agricultural and horticultural crops. It is a fungus that belongs to the class Dothideomycetes and the family Corynesporascaceae. Commonly known as the *Corynespora* leaf spot pathogen, it can infect various plant species, including vegetables, fruits, ornamental plants, and trees. The disease caused by *Corynespora cassiicola* manifests as circular to irregular-shaped lesions on leaves, stems, and fruits. These lesions typically have a dark brown to black appearance with a yellow halo around them. As the infection progresses, the affected plant tissues may dry up and eventually lead to defoliation, reducing the crop's productivity and quality. *Corynespora cassiicola* is a highly adaptable pathogen, thriving in warm and humid climates. It can spread through wind-dispersed spores, contaminated plant debris, or through human activities, such as farm equipment movements or infected plant material transportation. Crop monoculture and favorable environmental conditions can promote its rapid spread and increase the severity of outbreaks. Farmers and plant pathologists use

various strategies to manage *Corynespora cassiicola*. These may include practicing crop rotation, avoiding waterlogged conditions, using disease-resistant plant varieties, and employing fungicides. Additionally, maintaining good farm hygiene by removing and disposing of infected plant debris can help reduce the pathogen's survival and spread. Continuous research is essential to understand the pathogen's biology and develop effective control measures to minimize its impact on agriculture and protect crop yields. Timely detection and appropriate management strategies are crucial to mitigate the economic losses caused by *Corynespora cassiicola* and safeguard global food security.[1,2,3,4,5]

Cinnamon oil has gained popularity as a natural antifungal agent for plants due to its potent fungicidal properties. Extracted from the leaves or bark of *Cinnamomum verum*, this essential oil contains active compounds like cinnamaldehyde, eugenol, and linalool that exhibit strong antifungal effects. When applied to plants, cinnamon oil forms a protective barrier that hinders fungal growth and development. It is particularly effective against common plant fungal pathogens such as powdery mildew, leaf spot, and damping-off diseases. The oil's ability to disrupt fungal cell membranes and inhibit enzyme activity contributes to its antifungal action. Application methods for cinnamon oil vary, with most gardeners using a diluted solution to avoid potential plant damage. Additionally, adding cinnamon oil to the soil can protect against soil-borne fungal infections. One significant advantage of cinnamon oil as an antifungal agent is its eco-friendliness, as it poses minimal risks to humans, animals, and beneficial insects. Its natural origin also makes it a preferred choice for organic gardening and sustainable agricultural practices. However, it's essential to exercise caution when using cinnamon oil on plants, as excessive concentrations may lead to phytotoxicity or harm beneficial microbial populations in the soil. Cinnamon oil's natural antifungal properties make it a promising alternative to synthetic fungicides for plant protection. When used responsibly, it can contribute to healthier plants and a more environmentally friendly approach to gardening and agriculture.[6,7,8,9]

The present study aims to evaluate the effectiveness of cinnamon oil as an antifungal agent against *Corynespora*, to determine the minimum inhibitory concentration (MIC) of cinnamon oil required to inhibit *Corynespora* growth, to assess the potential of cinnamon oil as an eco-friendly alternative to synthetic fungicides for managing *Corynespora* infections and to provide valuable insights into the potential application of cinnamon oil in agriculture for controlling *Corynespora*-related crop diseases.

Materials and Methods

- Sample collection

Seed Sample

Untreated watermelon seeds were collected from Indian Institute of Horticultural Research, Bengaluru, Karnataka

Fungal strain

Corynespora cassiicola was isolated from watermelon seeds by agar plate method[10].

Essential oil

Cinnamon oil was collected from local market, Bengaluru.

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Preparation of different concentrations of cinnamon oil

1. 100% - Concentrated oil was used
2. 80% - 4ml oil in 1 ml acetone
3. 60% - 3 ml oil in 2 ml acetone
4. 40% - 2 ml oil in 3 ml acetone
5. 20% - 1 ml oil in 4 ml acetone
6. 0% or Control – Untreated plates

- Antifungal Assay

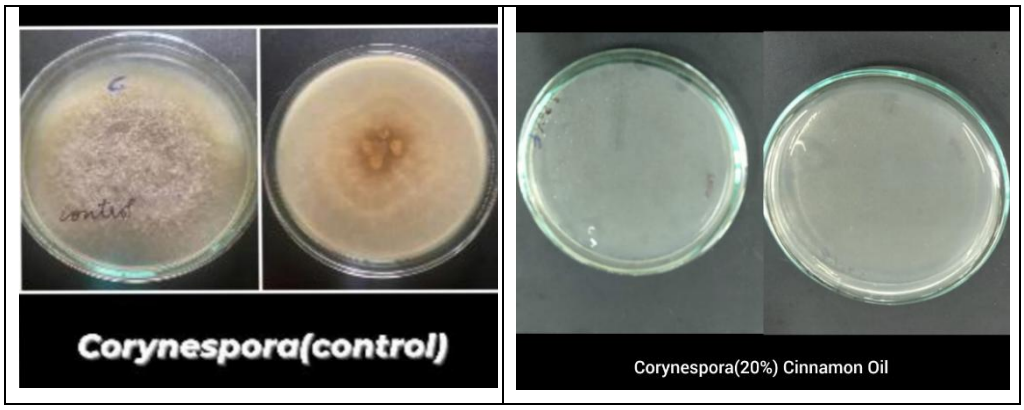
Poisoned Food Technique[11] was used to test the antifungal property of Cinnamon Oil against *Corynespora cassiicola*. Different concentrations of cinnamon oil viz., 20%, 40%, 60%, 80% and 100% were incorporated in potato dextrose agar media at 1000 ppm. Control plates without cinnamon oil were also prepared. After inoculation, the plates were incubated at 28°C for seven days. After seven days zone of inhibition was calculated and recorded.

Results

Results revealed that cinnamon oil was successful in inhibiting the growth of *Corynespora cassiicola* at all concentrations.

Table 1: Antifungal activity of Cinnamon oil against *Corynespora cassicola*

Essential oil	Concentration	Mean colony diameter (mm)	Percent of inhibition
Control	Control	90	0%
Cinnamon oil	20%	00	100%
Cinnamon oil	40%	00	100%
Cinnamon oil	60%	00	100%
Cinnamon oil	80%	00	100%
Cinnamon oil	100%	00	100%



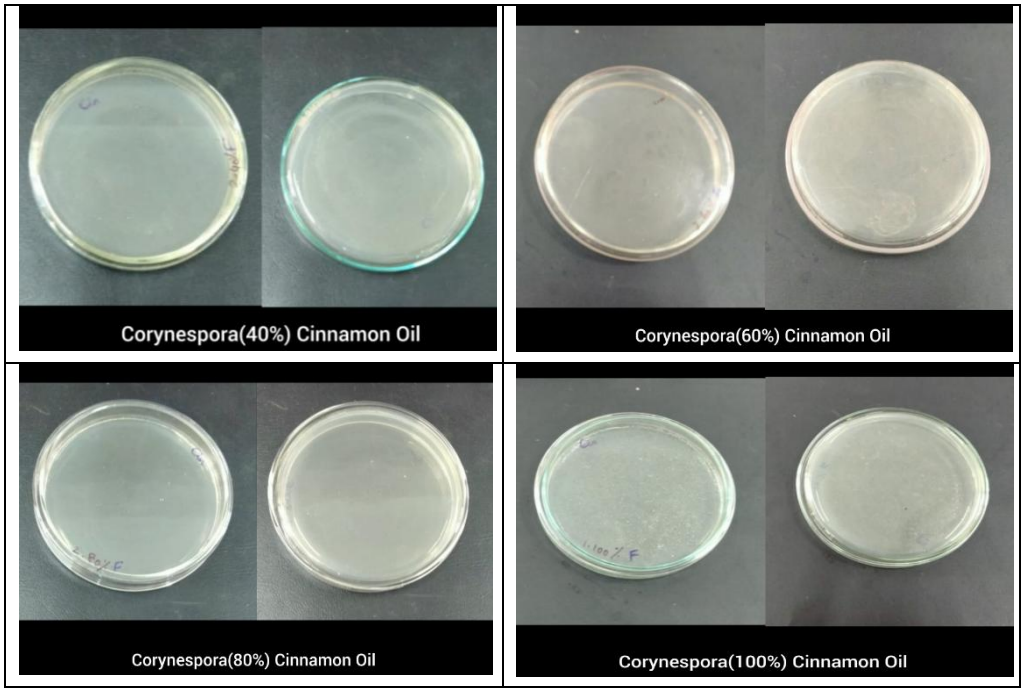


Fig 1: Antifungal activity of Cinnamon oil against *Corynespora cassicola*

Discussion

The antifungal activity of natural products against plant pathogens has gained significant attention in recent research.[12] The present study aimed to investigate the antifungal activity of cinnamon oil against *Corynespora cassiicola*, highlighting the potential of cinnamon oil as a natural alternative to synthetic fungicides. *Corynespora cassiicola* is a notorious plant pathogen responsible for causing various plant diseases, leading to significant economic losses in agriculture.[1,2] Synthetic fungicides have been conventionally used to control this pathogen; however, their prolonged use has raised concerns about environmental pollution, development of resistance, and potential health risks.[13] Therefore, exploring natural alternatives like essential oils, particularly cinnamon oil, has become imperative. Cinnamon oil, derived from the bark of *Cinnamomum* trees, has been recognized for its broad-spectrum antimicrobial properties, including antifungal activity. The primary active compounds responsible for this activity are cinnamaldehyde, eugenol, and cinnamic acid.[6,7] These compounds have been shown to inhibit fungal growth by disrupting cell membranes, interfering with metabolic processes, and inducing oxidative stress. Several studies have investigated the efficacy of cinnamon oil against *Corynespora cassiicola* in vitro and in planta. In vitro assays revealed significant inhibition of fungal growth and spore germination when treated with different concentrations of cinnamon oil. Furthermore, microscopic analysis demonstrated morphological changes in fungal hyphae and spores after exposure to cinnamon oil, confirming its potential as a fungicidal agent.[14,15,16]

Despite the encouraging findings, some challenges need to be addressed before cinnamon oil can be fully integrated into commercial agricultural practices. These challenges include optimizing application methods and determining the most effective concentrations to maximize its antifungal activity while minimizing any potential negative effects. Additionally, investigating the potential for resistance development and exploring the ecological impacts of cinnamon oil on non-target organisms are crucial aspects of further research.

Conclusion

In conclusion, the antifungal activity of cinnamon oil on *Corynespora cassiicola* shows great promise as a natural and eco-friendly alternative to synthetic fungicides. Its effectiveness in inhibiting fungal growth and disease development, along with its safety profile, makes it an attractive option for sustainable disease management in agriculture. However, continued research and field trials are necessary to fully understand its practical application and address any challenges that may arise. Embracing such natural solutions can pave the way for a more sustainable and environmentally friendly future in agriculture.

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