

Bio-efficacy of Eucalyptus (*Eucalyptus globulus*) Oil Against Fungal Pathogens of Cabbage (*Brassica oleracea* var. *capitata*)

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Abstract:

Cabbage (*Brassica oleracea* var. *capitata*) is a widely cultivated vegetable crop prone to several insect pests and fungal pathogens, leading to considerable yield losses. The present study investigates the bioefficacy of essential oil extracted from *Eucalyptus globulus* against fungal pathogens like *Alternaria brassicae* and *Sclerotinia sclerotiorum*. Laboratory bioassays and in vitro antifungal tests demonstrated that Eucalyptus oil possesses significant antifungal properties. The oil inhibited fungal mycelial growth in a dose-dependent manner. The findings suggest that *Eucalyptus globulus* oil could serve as a potential bio-based alternative to synthetic pesticides for sustainable cabbage production.

Introduction:

Cabbage is an important cruciferous vegetable grown extensively for its nutritional and economic value. However, its cultivation is severely threatened by various insect pests and fungal pathogens. Among these, *Alternaria brassicae*, and *Sclerotinia sclerotiorum* are among the most destructive, causing direct feeding damage or secondary infections that reduce market value and yield.

Traditional control methods rely heavily on chemical pesticides and fungicides. While effective, these chemicals contribute to environmental pollution, pest resistance, and residue problems. In this context, plant-derived essential oils offer a promising eco-friendly alternative. *Eucalyptus globulus* oil, rich in bioactive compounds such as 1,8-cineole, has been reported to possess insecticidal and antimicrobial properties.

This study aims to evaluate the bioefficacy of *Eucalyptus globulus* oil against fungal pathogens of cabbage through laboratory and in vitro assessments.

Materials and Methods:

1. Plant Material and Essential Oil Extraction: Fresh leaves of *Eucalyptus globulus* were collected and shade-dried for 7 days. The essential oil was extracted using hydro-distillation in a Clevenger apparatus. The oil was collected, dried over anhydrous sodium sulfate, and stored at 4°C until use.

2. Antifungal Activity Test: The antifungal activity of Eucalyptus oil was evaluated against *A. brassicae* and *S. sclerotiorum* using the poisoned food technique. PDA medium was amended

with different oil concentrations (0.25%, 0.5%, 1%, and 2%). Fungal plugs (5 mm) were placed at the center of the plates, and radial growth was measured after 5–7 days of incubation at 28°C.

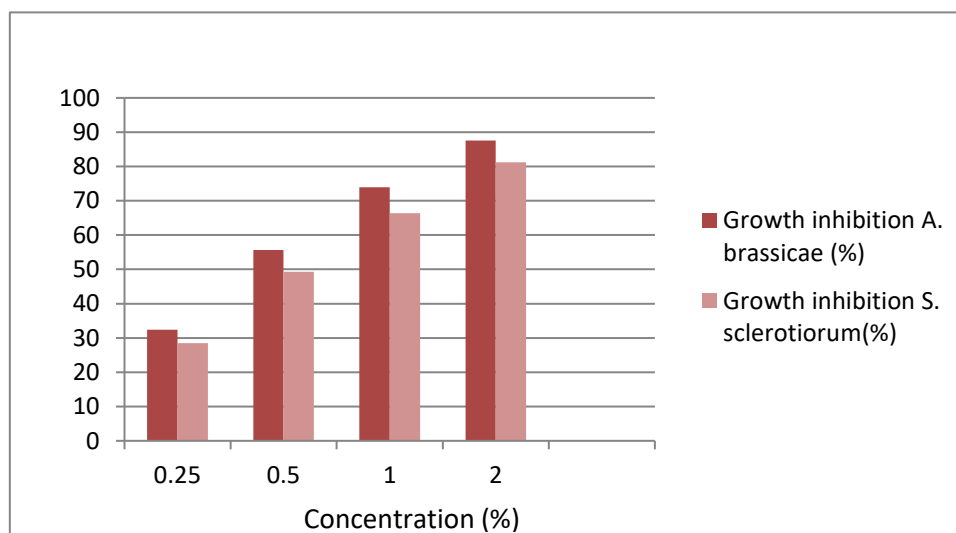
3. Statistical Analysis: Data were analyzed using ANOVA followed by Tukey's HSD test ($p < 0.05$) to determine the significance of differences among treatments.

Results:

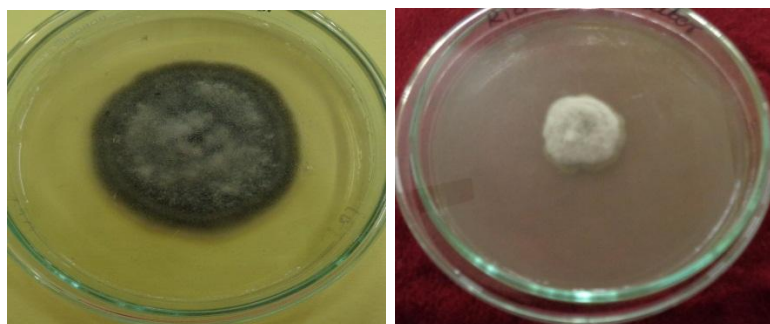
Antifungal Activity: Fungal growth was significantly inhibited at higher concentrations of Eucalyptus oil. At 2% concentration, the radial growth of *A. brassicae* was inhibited by 87.6 %, and *S. sclerotiorum* by 81.2%.

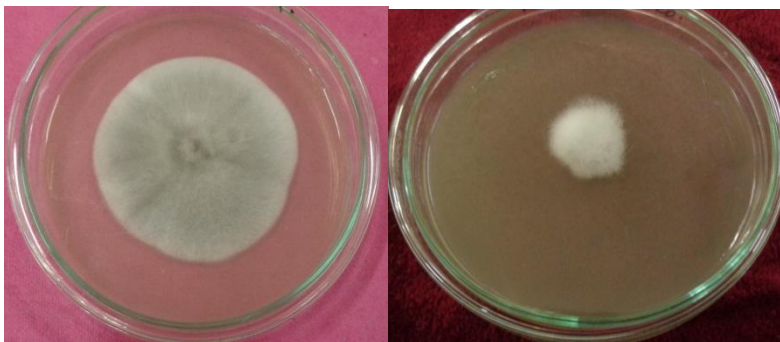
Table: Antifungal activity of Eucalyptus oil against *Alternaria brassicae*, and *Sclerotinia sclerotiorum*

Sr.No.	Concentration (%)	Growth Inhibition - <i>A. brassicae</i> (%)	Growth Inhibition - <i>S. sclerotiorum</i>
	0.25	32.4	28.5
	0.5	55.6	49.3
	1.0	73.9	66.4
	2.0	87.6	81.2



Graph: Concentration of *Eucalyptus* oil vs growth inhibition of mycelium of fungal pathogen



Alternaria brassicae- Contol Alternaria brassicae- Treated*Sclerotinia sclerotiorum- Control**Sclerotinia sclerotiorum- Treated*

Discussion:

The study demonstrates that *Eucalyptus globulus* oil has significant bioefficacy against major fungal pathogens of cabbage. The strong antifungal activity can be attributed to the presence of monoterpenes like 1,8-cineole, antifungal action may involve disruption of fungal cell membranes and inhibition of spore germination.

These results are consistent with previous studies highlighting the pesticidal potential of *Eucalyptus* species. Given its broad-spectrum activity and low toxicity to non-target organisms, *Eucalyptus* oil can be integrated into pest management programs as a safer alternative to synthetic chemicals.

Conclusion:

Eucalyptus globulus essential oil exhibits potent antifungal properties against pests and pathogens of cabbage. Its application could significantly reduce reliance on conventional agrochemicals and promote sustainable agricultural practices. Further field trials and formulation development are warranted to evaluate its commercial viability.

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