wjpmr, 2025, 11(3), 161-163

SJIF Impact Factor: 6.842

WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.wjpmr.com

Research Article

ISSN 2455-3301

WJPMR

# ANTIMICROBIAL EFFICACY OF EUCALYPTUS, CINNAMON, AND OREGANO ESSENTIAL OILS: A COMPARATIVE STUDY

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**Article Received on 03/01/2025** **Article Revised on 23/01/2025** **Article Accepted on 12/02/2025**

## ABSTRACT

The emergence of multidrug-resistant pathogens in recent years has necessitated the development of alternative antimicrobial drugs. Essential oils derived from medicinal plants have attracted significant attention because of their broad-spectrum antimicrobial properties. This study investigated the antimicrobial efficacy of eucalyptus (*Eucalyptus globulus*), cinnamon (*Cinnamomum zeylanicum*), and oregano (*Origanum vulgare*) essential oils against a panel of clinically relevant bacterial strains. The oils were tested using the agar disk diffusion method. Results demonstrated that all three essential oils exhibited significant antimicrobial activity, with cinnamon oil showing the highest efficacy, followed by oregano and eucalyptus. These findings suggest that these essential oils, particularly cinnamon, hold promise as natural antimicrobial agents with potential applications in pharmaceuticals, food preservation, and alternative medicine.

**KEYWORDS:** Essential oils, antimicrobial activity, Eucalyptus, cinnamon, oregano, multidrug resistance, natural antimicrobials.

## INTRODUCTION

In recent years, antimicrobial resistance (AMR) has emerged as the global health threat that needs immediate intervention.[1,2] AMR occurs when microbes develop the ability to withstand the effects of antimicrobial agents via various mechanisms.[3]

Although AMR is a natural phenomenon, the continuous misuse and overprescription of antibiotics have rapidly accelerated its course.[4] Several studies have shown that essential oils and their chemical constituents exert antimicrobial effects against a range of microorganisms, including bacterial, fungal, and viral pathogens.[5-8] Generally, the biological properties of essential oils are determined by their major components.[9] With many antimicrobials becoming useless owing to AMR, there is growing interest in the use of essential oils as alternatives.[10] There are various methods for evaluating the antimicrobial activity of microbes, such as disk diffusion, well diffusion, and broth or agar dilution[10] The present study evaluated the antimicrobial activity of Eucalyptus, Cinnamon, and Oregano essential oil by comparing their zones of inhibition.

## MATERIALS AND METHODS

**Essential Oil:** Eucalyptus (Eucalyptus globulus), cinnamon (Cinnamomum verum), and oregano (Origanum vulgare) essential oils were obtained from reputable suppliers.

### Microbial Strains

The antimicrobial activity was tested against Gram-positive bacteria (*Staphylococcus aureus)* Gram-negative bacteria (*Escherichia coli).*

Preparation of Standard Culture Inoculum of Test Organisms: Escherichia coli and Staphylococcus aureus were used for the study. Three or four isolated colonies were inoculated in 2 ml nutrient broth and incubated at 30–35 °C for 24 hours.

### Agar Disk Diffusion Assay

The antimicrobial activity was assessed using the agar disc diffusion method.

1. Mueller-Hinton agar was prepared.

| Ingredient | Amount |
|---|---|
| Beef Extract | 2.0 g |
| Acid Hydrolysate of Casein | 17.5 g |
| Starch | 1.5 g |
| Agar | 17.0 g |
| Distilled Water | 1 liter |
| pH (adjusted to neutral at 25 °C) | - |

2. The prepared culture media was put in Petri dish and sterilized using autoclaved at 121 °C for 15-20 minutes to sterilize.
3. The plates were inoculated with the bacterial strains.
4. Filter disc of 6mm diameter was cut and impregnated with essential oil. Plates were incubated at 37°C for 24 hours.
5. Zones of inhibition (ZOI) were measured in millimeters using caliper.

## RESULTS

### 3.1. Antimicrobial Activity: The average zones of inhibition were measured as follows.

| Essential Oil | Zone of Inhibition (mm) | |
|---|---|---|
| | E. coli | S. aureus |
| Eucalyptus | 13.6 | 17 |
| Cinnamon | 23.3 | 25.4 |
| Oregano | 24 | 22 |

All three essential oils exhibited significant antimicrobial activity against the tested strains. Cinnamon oil demonstrated the highest efficacy, followed by oregano and eucalyptus.

**Comparative Analysis:** Cinnamon oil was significantly more effective against Gram-positive bacteria, whereas oregano oil showed higher activity against Gram-negative bacteria. Eucalyptus oil exhibited moderate activity against all tested strains.

## DISCUSSION

Essential oils consist of different components originating from different biosynthetic pathways that can typically be categorized into two main types: terpenoids, which are the most prominent, and non-terpenoids, which are primarily composed of phenylpropanoids. These oils exhibit antimicrobial properties that affect the plasma membrane, cell wall, cell division, and protein synthesis of microorganisms. The chemical diversity of essential oils increases the likelihood of containing certain constituents that can interfere with protein synthesis, thereby strengthening their wide-ranging antimicrobial effects.[12] The high cinnamaldehyde content in cinnamon likely contributes to its superior antimicrobial activity.[13] Oregano oil is rich in carvacrol and thymol, which also exhibit strong antimicrobial properties.[14] Eucalyptus oil containing 1,8-cineole showed moderate activity, which is consistent with previous studies.[15] These findings align with the existing literature, highlighting the potential of these essential oils as natural antimicrobial agents. However, further research is needed to evaluate their safety, stability, and synergistic effects with those of conventional antibiotics.

## CONCLUSION

This research suggests that essential oils such as eucalyptus, cinnamon, and oregano oil can play a crucial role as replacements for antibiotics. Cinnamon and oregano oils can be used in the development of new treatments, especially because of their strong effects against gram-positive and gram-negative bacteria. More studies are needed regarding the safety, stability, and possible synergistic effects of these oils on current antibiotics. The use of essential oils in clinical treatment can be another method of combating difficult-to-cure MDR microorganisms.

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