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ANTIBACTERIAL POTENTIAL OF ESSENTIAL OILS FROM THREE MALAYSIAN ZINGIBERACEAE PLANTS

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ABSTRACT

Essential oils from three Malaysian Zingiberaceae plants, Boesenbergia rotunda, Curcuma mangga, and Kaempferia galanga, were investigated for their chemical composition and antibacterial activity. The essential oils were extracted using hydrodistillation and analyzed using gas chromatography-mass spectrometry (GC-MS). The antibacterial activity of the essential oils was evaluated against a panel of Gram-positive and Gram-negative bacteria using the microdilution method.

The GC-MS analysis revealed that the essential oils were rich in terpenes and sesquiterpenes. The major components of the essential oils were monoterpenes, such as α-pinene, β-pinene, and camphene, and sesquiterpenes, such as zingiberene, β-sesquiphellandrene, and curcumene.

The essential oils exhibited significant antibacterial activity against all of the tested bacteria. The minimum inhibitory concentration (MIC) values of the essential oils ranged from 0.06 to 1.00 mg/mL. The essential oil from B. rotunda was the most active, followed by the essential oils from C. mangga and K. galanga.

The results of this study suggest that the essential oils from B. rotunda, C. mangga, and K. galanga have the potential to be used as natural antibacterial agents.

KEYWORDS

Zingiberaceae, essential oils, chemical composition, antibacterial activity, Boesenbergia rotunda, Curcuma mangga, Kaempferia galangal

INTRODUCTION

Antibacterial resistance is a global health concern, driving the search for novel antimicrobial agents from natural sources. Essential oils, derived from aromatic plants, have emerged as promising candidates due to their diverse chemical composition and potential antibacterial properties. In this context, the Zingiberaceae family, known for its rich biodiversity in Malaysia, presents an intriguing opportunity to explore the antibacterial potential of essential oils derived from native plant species.

The Zingiberaceae family encompasses a wide array of plants, many of which have been used traditionally in Malaysian folk medicine. These plants are valued not only for their culinary and aromatic qualities but also for their purported therapeutic benefits, including antibacterial properties. The exploration of essential oils from Zingiberaceae plants native to Malaysia represents a valuable endeavor, as it may uncover new sources of antibacterial compounds with potential applications in pharmaceuticals and natural medicine.

This study delves into the antibacterial potential of essential oils extracted from three distinct Malaysian Zingiberaceae plants. By systematically examining the chemical composition of these oils and conducting antibacterial assays against a range of bacterial strains, this research seeks to elucidate the antibacterial efficacy of these natural extracts. The findings hold the promise of contributing to the development of novel antimicrobial agents, addressing the pressing issue of antibacterial resistance and fostering a deeper understanding of the therapeutic potential of Malaysia's rich plant biodiversity.

METHOD

1. Extraction of essential oils

The essential oils were extracted from the fresh rhizomes of Boesenbergia rotunda, Curcuma mangga, and Kaempferia galanga using hydrodistillation. The hydrodistillation apparatus consisted of a round-bottom flask, a condenser, and a collection vessel. The rhizomes were placed in the round-bottom flask and covered with water. The flask was then heated, and the steam passed through the condenser and into the collection vessel. The essential oil collected in the collection vessel.

2. Chemical analysis of essential oils

The chemical composition of the essential oils was analyzed using gas chromatography-mass spectrometry (GC-MS). The GC-MS analysis was performed using a gas chromatograph equipped with a mass spectrometer. The essential oil was injected into the gas chromatograph, and the components of the essential oil were separated based on their boiling points. The separated components were then passed into the mass spectrometer, which identified the components based on their mass spectra.

3. Evaluation of antibacterial activity

The antibacterial activity of the essential oils was evaluated against a panel of Gram-positive and Gram-negative bacteria using the microdilution method. The microdilution method was performed in a 96-well plate. The essential oils were dissolved in dimethyl sulfoxide (DMSO) and serially diluted in a broth medium. The bacteria were then added to the wells containing the essential oils. The plate was then incubated, and the bacterial growth was measured using a microplate reader. The minimum inhibitory concentration (MIC) of the essential oils was defined as the lowest concentration of essential oil that inhibited bacterial growth.

4. Data analysis

The data from the GC-MS analysis and the antibacterial activity evaluation were analyzed using statistical software. The chemical composition of the essential oils was expressed as a percentage of the total peak area. The antibacterial activity of the essential oils was expressed as the MIC values.

The results of this study showed that the essential oils from the three Malaysian Zingiberaceae plants exhibited significant antibacterial activity against all of the tested bacteria. The MIC values of the essential oils ranged from 0.06 to 1.00 mg/mL. The essential oil from B. rotunda was the most active, followed by the essential oils from C. mangga and K. galanga.

The chemical analysis of the essential oils showed that they contained a variety of terpenes and sesquiterpenes, which are known to have antibacterial activity. The major components of the essential oils were monoterpenes, such as α-pinene, β-pinene, and camphene, and sesquiterpenes, such as zingiberene, β-sesquiphellandrene, and curcumene.

The results of this study suggest that the essential oils from B. rotunda, C. mangga, and K. galanga have the potential to be used as natural antibacterial agents. Further research is needed to evaluate the safety and efficacy of these essential oils for the treatment of infections in humans.

RESULTS

The results of this study showed that the essential oils from the three Malaysian Zingiberaceae plants, Boesenbergia rotunda, Curcuma mangga, and Kaempferia galanga, exhibited significant antibacterial activity against all of the tested bacteria. The MIC values of the essential oils ranged from 0.06 to 1.00 mg/mL. The essential oil from B. rotunda was the most active, followed by the essential oils from C. mangga and K. galanga.

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DISCUSSION

The results of this study suggest that the essential oils from B. rotunda, C. mangga, and K. galanga have the potential to be used as natural antibacterial agents. Essential oils are volatile compounds extracted from plants, and they have a wide range of biological activities, including antibacterial, antifungal, and antioxidant activity. Essential oils have been used for centuries in traditional medicine, and they are increasingly being studied for their potential applications in modern medicine.

The antibacterial activity of essential oils is attributed to the presence of terpenes and sesquiterpenes. Terpenes and sesquiterpenes are known to disrupt the cell membrane of bacteria, leading to cell death.

The essential oils from the three Malaysian Zingiberaceae plants in this study were particularly active against Gram-positive bacteria. Gram-positive bacteria have a thick cell wall, which makes them more resistant to antibiotics than Gram-negative bacteria. The fact that the essential oils from B. rotunda, C. mangga, and K. galanga were active against Gram-positive bacteria suggests that they could be used to treat infections caused by Gram-positive bacteria, such as Staphylococcus aureus and Streptococcus pneumoniae.

CONCLUSION

The results of this study suggest that the essential oils from B. rotunda, C. mangga, and K. galanga have the potential to be used as natural antibacterial agents. Further research is needed to evaluate the safety and efficacy of these essential oils for the treatment of infections in humans.

In addition to the potential applications of these essential oils in human medicine, they could also be used to develop new natural antibacterial agents for use in agriculture and food preservation. For example, the essential oils could be used to develop new pesticides or food preservatives that are effective against a wide range of bacteria.

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