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RESEARCH ARTICLE

ANTIMICROBIAL EFFECT OF OIL EXTRACT OF *MERIANDRA BENGHALENSIS* LEAVES FROM YEMEN

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Abstract

Background: Twenty three genera and twenty three species of the *Lamiaceae* family are native to Yemen. The greatest antibacterial efficacy against a wide range of pathogens, including *Candida albicans*, *Staphylococcus aureus*, *Aspergillus fumigatus*, and *Escherichia coli* was demonstrated by *Lamiaceae* essential oils. The primary components of *Lamiaceae* essential oils, including as carvacrol, thymol, p-cymene, 1,8-cineole, and caryophyllene, may be responsible for these characteristics.
Method: The plant green branches and new leaves were sliced into little bits. A Clevenger-style all-glass equipment was used to hydro distills the essential oil for five hours in order to separate it from each component. After being moved to a glass vial with a screw top, each oil was dried (with Na_2SO_4) and kept at 4°C in the dark until analysis. For assessing antibiotic sensitivity, a variety of bacterial and fungal strains kept in stock culture at the Al-Mamoun laboratories center were utilized, including: Gram-positive bacteria (*Staphylococcus aureus*), Gram-negative bacteria (*Klebsiella pneumonia*, *Escherichia coli*) and Fungi *Candida albicans*. In dichloromethane (DCM), the essential oil that had been previously synthesized was diluted 1/5, 1/3, and 1/ 1 v/v.
Result: The plant has significant effect on *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumonia* and, *Candida albicans*. In addition, the extract has high effect on *Candida albicans* than on bacteria. And their more effect on *Klebsiella pneumoniae* than *Escherichia coli*.
Conclusions: Result showed the plant has significant effect on *staph. Aureus*, *E coli*, *Klebsielle*, *Candida albicans*. The extract has high effect on *Candida albicans* than bacteria. Also the extract has high effect on *Klebsiella* than *E. coli*. The oil extract has more effect on gram negative than gram positive.
Keywords: Antimicrobial activity, essential oils, *Meriandra benghalensis*.

INTRODUCTION

The largest family in the order *Lamiaceae*, with 252 genera and 6700 species, is the mint family of flowering plants, *Lamiaceae* (previously known as *Labiatae*). The *Lamiaceae* family is found almost everywhere, and many of its species are grown for their fragrant foliage and eye-catching blossoms. When it comes to flavor, smell, or therapeutic purposes, the family is very important[1,2]. Twenty-three genera and twenty-three species of the *Lamiaceae* family are native to Yemen. The greatest antibacterial efficacy against a wide range of pathogens, including *Candida albicans*, *Staphylococcus aureus*, *Aspergillus fumigatus*, and *Escherichia*, was demonstrated by *Lamiaceae* essential oils[3,4]. The primary components of *Lamiaceae* essential oils, such as carvacrol, thymol, p-cymene, 1, 8-cineole, and caryophyllene[5,7], may be responsible for these characteristics. A growing global concern for public health is food-borne illnesses due to the rise in microbial resistance to several antibiotics. In under developed nations, foodborne microorganisms constitute the primary cause of disease and mortality[8]. A wide range of intestinal bacteria, aerobes and anaerobes, viral pathogens, and parasites are included in the spectrum of foodborne pathogens[9].

E. coli, and *S. aureus* are regarded as the most prevalent foodborne pathogens[10]. Naturally occurring antimicrobial compounds are becoming more and more popular as a result of the "back to nature" movement, rising food safety concerns, and consumer demand for natural products that are environmentally beneficial. Numerous plant extracts can be used to preserve food, and essential oils have a broad spectrum of antibacterial properties[11].

Examining the antibacterial activity of *Meriandra bengalensis* leaf oil on gram positive, gram negative, and *Candida albican* bacteria is the primary objective of this study.

MATERIALS AND METHODS

All the chemicals and solvents were purchased from commercial Suppliers (loba chemie, Himedia laboratories).The medicinal *Lamiaceae* taxa was collected; *M. bengalensis*, during the rainy season in 24/8/2023 from different locations in Bani Matar District, Sana'a governorate, Yemen. The identification of the specimens was done by utilizing the available taxonomic and floristic literatures Dr. Fuad Al-hood, Aden University. All the collected parts of the plants were washed. Moreover, left to dry completely under a shade for two week. The dried specimens was then ground using an electrical mill.

Isolation of the essential oil

The plant's green branches and new leaves were sliced into little bits. A Clevenger-style all-glass equipment was used to hydro distills the essential oil for five hours in order to separate it from each component. After being moved to a glass vial with a screw top, each oil was dried (with Na_2SO_4) and kept at 4°C in the dark until analysis.

Antimicrobial screening

A series of bacterial and fungal strains available in stock culture of the Al-Mamoun laboratories center, were used for antibiotic sensitivity testing comprising: Gram-positive bacteria *S. aureus*, Gram-negative bacteria *K. pneumonia*, *E. coli* and Fungi *C. albicans* . The previously prepared essential oil was diluted1/1, 1/3, 1/5 v/v in dichloromethane (DCM) was used as a negative control. The agar diffusion method[12] was applied using Mueller Hinton agar medium inoculated with the bacterial or fungal suspension of the test organisms. The oils or the control was impregnated into 5 mm-diameter discs. The discs were then inserted into the culture medium's surface. Discs containing conventional antibacterial, gentamicin, and amphotericin B agents were utilized, in that order. The plates were incubated for 24-48 hours at 35–37°C for bacteria, 48 hours at 25°C for filamentous fungus, and 24–48 hours at 30°C for yeasts. Following incubation, the inhibitory zone diameters were measured in millimeters, and the data were assembled into a result table. *M. benghalensis* oil's lowest inhibitory concentrations (MIC) against the tested microorganisms were also ascertained using the micro dilution technique[13].

Statistical analysis

The data were analyzed using SPSS version 21. The results are reported as mean ± SEM. One-way analysis of variance (ANOVA) followed by Turkey's HSD *post hoc* test was used to compare results among and within the groups. The results were considered significant when $p<0.05$.

RESULTS AND DISCUSSION

Antimicrobial properties were induced in numerous *Lamiaceae* plants against a diverse array of bacteria and fungi. For instance, *Dracocephalum kotschyi Boiss* was found to have antibacterial capabilities against 12 types of microorganisms, with the highest activity against *C. albicans, Bacillus subtilis, and Aspergillus brasiliensis*[14]. Meanwhile, *P. aeruginosa, Shigella dysenteriae*, and *K. pneumoniae* may be susceptible to the bactericidal effects of essential oils extracted from Salvia hydrangea leaves and flowers[15].

The oils' minimum inhibitory concentration (MIC) and zone of inhibition were shown in Table 1. Studies that indicated a drug's potency based on its inhibition zone have shown that: over 18 mm is regarded substantial activity, 16–18 mm is considered good activity, 12–15 mm is considered moderate, 12–14 mm is considered low activity, and 6–9 mm is considered no activity[16,17]. *M. bengalensis* oil exhibited noteworthy antimicrobial properties against *C. albicans*, *E. coli*, *Klebsielle pneumonia*, and *S. aureus* at a concentration of 1:1, surpassing that of kanamycin and ampicillin. Additionally, *S. aureus* showed similar activity to ampicillin at a concentration of 1:3. At a concentration of 1:3, it had moderate action against *K. pneumoniae*. At concentrations of 1:3 and 1:5, a modest activity was generated against *E. coli* and *Staphylococcus aurous*.

Figure 1: *E. coli* positive control.

Figure 2: Antimicrobial activity of essential oil against *E. coli*.

Table1: Antimicrobial activity of the oil of *M. benghalensis* as inhibition zone diameter.

Essential oils	*S. aureus*	*E. coli*	*K. pneumoniae*	*C. albicans*
Disc diffusion assay				
1:1	17±0.37	20±0.58	24±0.63	40±0.25
1:3	14±0.44	13±0.12	15±0.37	28±0.37
1:5	12±0.25	13±1.2	12±0.37	15±0.58
Positive control				
Ampicillin	10±0.44			
Kanamycin		18±0.14	18±0.34	
Amphotericin				10±0.10

Results are Mean±SD of triplicate values.
6-9 mm: no activity; 12-15 mm: low activity; 15-18 mm: good activity; above 18 mm: significant activity.

Figure 3: *Klebsiella pneumoniae* positive control.

Figure 4: Antimicrobial activity of essential oil against *Klebsiella pneumoniae*.

Figure 5: *C. albicans* positive control.

Figure 6: Antimicrobial activity of essential oil against *C. albicans*.

Figure 7: *S. aureus* positive control.

Figure 8: Antimicrobial activity of essential oil against *S. aureus*.

Found in the oil of *M. benghalensis* from Yemen, the diameters of the inhibition zones, minimum inhibitory concentrations (MIC) and minimum bactericidal concentrations (MBC) *M. benghalensis* for the microorganisms tested are presented in Table 1. The most sensitive microorganisms were *K. pneumoniae*, *E coli* and *C. albicans* with inhibition zones of 24, 20, and 40 mm and MIC values of 1:1 for all. A strain of Gram-positive *S. aureus* appeared to be the most resistant one. At the application of 1:3, antifungal activity of MB with inhibition zones of 28 mm was observed against the *C. albicans*.

Limitation of study

Insufficient sample size for statistical measurement accurately. Limited to access to GC chromatography to analysis. Lack of previous research studies on the topic.

CONCLUSIONS

Essential oil of *M. benghalensis* was extracted and study the antimicrobial activity by disc method assay the result showed the plant has significant effect on *staph. Aureus, E coli, K. pneumoniae, C. albicans*. The extract has high effect on *C. albicans* than bacteria. Also the extract has high effect on *K. pneumoniae* than *E. coli.* The oil extract has more effect on gram negative than gram positive.

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AUTHORS CONTRIBUTION

Ali AAA: writing original draft. **Al-kaf AG:** conceptualization. **Abas MNA:** data organization, laboratory examinations. **Alseraji ZMA:** literature searches, research design. **Aklan ASA:** data collection and processing. **Ahmed BL:** conceptualization, methodology. All the authors read and approved the final version of the manuscript.

DATA AVAILABILITY

Data will be `made available on request

CONFLICT OF INTEREST

None to declare.

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