RESEARCH PAPER

# EXPLORING THE PHYTOCHEMICALS AND ANTIBACTERIAL POTENTIAL OF *MEMECYLON UMBELLATUM* BURM.F.

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**ABSTRACT**

*Memecylon umbellatum*, is a versatile ethnomedicinal plant that is indigenous to Indian forests and belongs to the family Melastomataceae. It is traditionally used in Ayurvedic and Siddha systems of medicine. The study examines the phytochemicals present in the leaves and stem of *Memecylon umbellatum* and investigates their antibacterial potential. Key bioactive constituents in *Memecylon umbellatum* leaves and stem were determined through qualitative phytochemical screening. Antibacterial efficacy was assessed against *Klebsiella pneumoniae* (MTCC 7162) and *Staphylococcus aureus* (MTCC 3160) via the disc diffusion method utilizing the solvents acetone, ethanol, aqueous, and petroleum ether. Phytoconstituents were identified using qualitative phytochemical analysis, and extracts revealed a promising zone of inhibition, validating the medicinal potential of these chemicals and enhancing the standardization of quality-controlled herbal drugs.

**Key words:** *Memecylon umbellatum*, phytochemical screening, antibacterial activity, disc diffusion method
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## INTRODUCTION

Ethnomedicinal plants have a vital part in the lives of individuals of rural and tribal communities. Thousands of medicinal plant species are used to treat various diseases and are considered an important therapeutic reserve to minimize these diseases [1]. Ethnomedicinal discoveries are valuable for the emergence of contemporary medicine. The information on medicinal and various other plants comes from the ancient people when they started learning and making use of these traditional plants for various purposes [2,3]. Medicinal plants contain some organic compounds which provide definite physiological action on the human body and these bioactive substances or the secondary metabolites are the reason for their medicinal value and include glycosides, tannins, steroids, alkaloids, terpenoids, carbohydrates, steroids, essential oils, etc. [4-6].

*Memecylon umbellatum* Burm.F. (Family: Melastomataceae) is a small evergreen shrub or tree having young tree branches and bears numerous umbellate cymes known as Ironwood tree, mostly distributed in coastal regions of the Deccan peninsula, the eastern and southern parts of India all along the Western Ghats and the Andaman Islands [7,8].

Phytochemicals are important for the plants to thrive or thwart other plants, animals, insects and microbial pests and pathogens. Secondary metabolites are those that are needed for the survival of the plants in a harsh environment. They form the smell, colour, taste of the plants, moreover they can also be used to protect humans from many diseases like cancer, diabetes, cardiovascular diseases, arthritis and aging etc. 'Phytomedicines' are a link between the traditional and modern medicine [9].

Infectious diseases are the leading cause of death world-wide. Antibiotic resistance has become a universal concern [10]. The clinical efficacy of many existing antibiotics is being threatened by the development of multidrug-resistant pathogens [11]. Herbal medicines are rich in various compounds, such as alkaloids, flavonoids, terpenoids, coumarins, tannins, antimicrobial peptides, and steroids, which can be used as an alternative or complement to conventional antibiotics [12- 16]. Many infectious ailments have been recognized to be treated using herbal medications throughout the history of mankind. Natural products, either as pure compounds or as standardized plant extracts, provide unlimited opportunities for new drug leads because of the unmatched availability of chemical diversity [17]. Hence in the present study the ethanol, acetone, petroleum ether and aqueous extracts of the leaves and stem of *Memecylon umbellatum* Burm.f., were explored for phytochemical constituents and the antibacterial activity against human clinical isolates.

## MATERIALS AND METHODS

### Sample Collection

Fresh leaves and stem parts of *Memecylon umbellatum* were collected from the home garden at Parassala, Thiruvananthapuram. The plant material was dehydrated under the shade condition for about one month and pulverized using a mechanical blender into a fine powder and transferred in a sterile container for further use.

**Solvent extraction**

Plant extract was prepared by Soxhlet extraction method. About 20gm of powdered plant material was uniformly packed into a thimble and extracted using the solvents ethanol, acetone, petroleum ether and aqueous. The process of extraction remains for 24 hours and the extract was taken in a beaker and kept on hot plate, heated at 30-40ºC till all the solvent got evaporated. Dried extract was kept in refrigerator at 4ºC for their future analysis.

**Phytochemical Screening**

Phytochemical analysis of the different plant extracts was performed using the methods described by Trease & Evans; Harborne [18- 19].

**Test Organisms**

The bacterial strains of human pathogens were *Staphylococcus aureus* (MTCC 3160) and *Klebsiella pneumoniae* (MTCC 7162). They were clinical isolates procured from Microbial Type Culture Collection and Gene Bank (MTCC) Chandigarh cultures of bacteria were maintained on nutrient agar slants at 4°C and sub-cultured on to nutrient broth for 24 h prior to testing.

**Antibacterial Assay**

Disc diffusion method by Bauer *et al*., [20] was followed to determine the antibacterial activity. Nutrient agar (NA) and Mueller Hinton Agar (Hi Media) plates were swabbed with 12h old - broth culture. Finally, the sample-loaded disc was placed on the surface of the Mueller-Hinton agar medium. The standard drug amikacin 10 mcg concentration disc was used for positive control, and an empty sterile disc was used for negative control. The plates were incubated at 37°C for 18-24 h for bacterial pathogens. Diameter of the inhibition zones was recorded. Triplicates were recorded and the experiment was repeated thrice and the average values were measured [21 – 23].

**RESULT AND DISCUSSION**

**Preliminary phytochemical screening**

The phytochemical examination of *Memecylon umbellatum* leaves and stem was conducted using different solvent extracts, including acetone, ethanol, petroleum ether, and aqueous. The qualitative analysis aimed on assessing the presence of phytochemicals such as alkaloids, carbohydrates, glycosides, proteins, flavonoids, terpenoids, phenols, tannins, saponins, and anthraquinones.

**Table 1: Phytochemical screening of various extracts of the leaves and stem of *Memecylon umbellatum* Burm.f.**

| Phytoconstituents | Ethanol | | Petroleum ether | | Acetone | | Aqueous | |
|---|---|---|---|---|---|---|---|---|
| | Leaf | Stem | Leaf | Stem | Leaf | Stem | Leaf | Stem |
| **Alkaloids** | - | - | - | - | + | - | - | - |
| **Carbohydrates** | + | + | + | - | + | + | + | - |
| **Glycosides** | + | + | + | - | + | - | - | - |
| **Proteins** | + | - | + | - | + | + | + | - |
| **Flavonoids** | + | - | + | + | + | - | + | - |
| **Terpenoids** | + | + | + | - | + | + | - | - |
| **Phenols** | + | + | + | + | + | + | + | + |
| **Tannins** | + | + | - | - | + | + | - | + |
| **Saponins** | + | - | - | - | + | + | - | - |
| **Anthraquinones** | - | - | - | - | - | - | - | - |

**Note: (+)** indicates the presence **(-)** indicates the absence

The current study on phytochemical analysis of *Memecylon umbellatum* leaves and stem identified array of bioactive compounds, as summarized in **Table 1.** Phenolic compounds were detected in all extracts. Flavonoids, proteins, glycosides, saponins and tannins were largely present in the leaf, while these compounds were weakly detected in the stem and showed the presence of terpenoids and phenols. Alkaloids were detected exclusively in the acetone leaf extract, while anthraquinones were absent in both stem and leaf. Among the solvents, the acetone leaf extract revealed the richer phytochemical diversity.

Furthermore, the phytochemical scrutiny of medicinal plants by Yadav and Agarwala [24] demonstrated the presence of saponins, flavonoids, phenols and tannins. The results with the prior studies and presence of similar compounds were observed in ethanolic extract and aqueous extracts of *Memecylon umbellatum* leaves which showed flavonoids, alkaloids, phenols and terpenoids [25, 26].

**Antibacterial Assay**

The antibacterial activity of *Memecylon umbellatum* leaf and stem extracts, done using acetone, ethanol, petroleum ether, and aqueous solvents, was evaluated against the bacterial pathogens *Staphylococcus aureus* (Gram-positive) and *Klebsiella pneumoniae* (Gram-negative).

**Table 2: Antibacterial activity of *Memecylon umbellatum* leaf against bacterial pathogens**

| No. | Bacterial pathogens | Zone of Inhibition (mm) | | | | |
|---|---|---|---|---|---|---|
| | | Amikacin | Acetone | Petroleum ether | Ethanol | Aqueous |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | *Staphylococcus aureus* | 22.04 ± 0.391 | 33.04 ± 0.12 | 13.04 ± 0.16 | 14.08± 0.06 | 10.94 ± 0.092 |
| 2 | *Klebsiella pneumoniae* | 18.92 ± 0.314 | 21.92 ± 0.15 | 8 ± 0.175 | 15.95± 0.08 | 8.84 ± 0.19 |

**Note:** Each value is a mean of three data ***mm**-Millimeter

**Table 3: Antibacterial activity of *Memecylon umbellatum* stem against bacterial pathogens**

| **No.** | **Bacterial pathogens** | **Zone of Inhibition (mm)** | | | | |
|---|---|---|---|---|---|---|
| | | **Amikacin** | **Acetone** | **Petroleum ether** | **Ethanol** | **Aqueous** |
| 1 | *Staphylococcus aureus* | 20.03 ± 0.391 | 15.01 ± 0.12 | 12.23 ± 0.16 | 13.09± 0.06 | 10.02 ± 0.092 |
| 2 | *Klebsiella pneumoniae* | 19.75 ± 0.314 | 16.28 ± 0.15 | 9.01± 0.175 | 13.05± 0.08 | 7.03 ± 0.19 |

**Note:** Each value is a mean of three data ***mm**-Millimeter

**Fig. 1: Antibacterial activity of *Memecylon umbellatum* leaf and stem against bacterial pathogens**

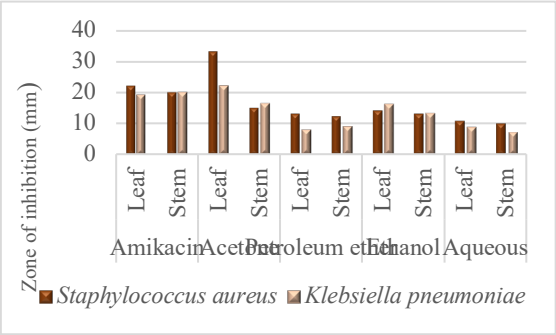


**PLATE 1: Antibacterial activity of *Memecylon umbellatum* leaf against bacterial pathogens.**

**PLATE 2: Antibacterial activity of *Memecylon umbellatum* stem against bacterial pathogens.**

The antibacterial potential of *Memecylon umbellatum* leaf extracts was assessed against selected bacterial pathogens, with results showed in **Table 2&3, Figure 1, and Plate 1&2**. The acetone leaf extract showed the highest inhibition zone against *Staphylococcus aureus* (33.04 ± 0.12 mm) compared to the stem (15.01 ± 0.12 mm) followed by ethanol leaf extract (14.08 ± 0.06 mm) also showed higher activity than the stem (13.09 ± 0.06 mm).

Similarly, against *Klebsiella pneumoniae*, acetone leaf extract (21.92 ± 0.15 mm) revealed greater inhibition than the stem (16.28 ± 0.15 mm), followed by ethanol leaf (15.95 ± 0.08 mm) and stem (13.05 ± 0.08 mm). Aqueous and petroleum ether extracts showed lower activity in both plant parts. However, Killedar *et al.,* [27] observed petroleum ether extracts exhibited the lowest overall activity against pathogens. The results scrutinized that leaf extracts possess stronger antibacterial potential than stem extracts.

## CONCLUSION

Among the four solvents studied, the acetone extract displayed the most antibacterial properties, making it the focus of further exploration. These results suggest the potential of isolating and identifying the bioactive molecules responsible for this activity, together with structural elucidation. This approach could lead to the discovery of novel therapeutic compounds, highlighting promising options for drug development and furthering pharmaceutical research.

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