



## In-Vitro Antibacterial Activity of Selected Medicinal Plants

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### ABSTRACT:

Medicinal plants have long been used as natural sources of therapeutic agents. Their antibacterial properties are mainly associated with secondary metabolites such as alkaloids, flavonoids, tannins, phenolics, saponins, terpenoids and glycosides. The present study focused on the comparative in-vitro antibacterial potential of three commonly used medicinal plants, namely *Azadirachta indica* (Neem), *Murraya koenigii* (Curry leaf) and *Psidium guajava* (Guava). Leaves of the selected plants were processed, extracted and subjected to preliminary phytochemical screening. The antibacterial activity of the extracts was evaluated against *Staphylococcus aureus* and *Escherichia coli* using the agar well diffusion method at concentrations of 25, 50, 75 and 100 mg/mL. The observations provided in the project file showed a concentration-dependent increase in inhibition zones for all three plant extracts. Among the selected plants, *Psidium guajava* showed the highest reported inhibition, followed by *Azadirachta indica* and *Murraya koenigii*. The findings indicate that these medicinal plants contain bioactive constituents with potential antibacterial activity and may serve as useful candidates for further investigation.

**Keywords:** Medicinal plants, antibacterial activity, *Azadirachta indica*, *Murraya koenigii*, *Psidium guajava*, agar well diffusion, phytochemicals.

### 1. Introduction:

Medicinal plants represent an important natural source of biologically active compounds. Plants synthesize a wide range of secondary metabolites that may contribute to their protective and therapeutic properties. Compounds such as flavonoids, tannins, phenolic compounds, alkaloids, terpenoids, saponins and glycosides have been associated with antimicrobial effects. The increasing interest in plant-based antibacterial agents has encouraged the investigation of traditionally used medicinal plants against pathogenic microorganisms.

In the present work, three medicinal plants were selected: *Azadirachta indica* (Neem), *Murraya koenigii* (Curry leaf) and *Psidium guajava* (Guava). These plants are widely recognized for their medicinal importance and contain several classes of phytoconstituents. The study was designed to compare their antibacterial activity against representative Gram-positive and Gram-negative bacteria. *Staphylococcus aureus* was selected as the Gram-positive organism, whereas *Escherichia coli* represented the Gram-negative organism.

### 2. Objectives:

- To select and process leaves of Neem, Curry leaf and Guava.
- To prepare extracts of the selected plant materials.
- To perform preliminary phytochemical screening.
- To investigate antibacterial activity against *S. aureus* and *E. coli*.
- To compare the antibacterial response of the three plant extracts at different concentrations.

### 3. Plant Profile:

#### 3.1 *Azadirachta indica* A. Juss. (Neem)



**Figure1: *Azadirachta indica* A. Juss. (Neem)**

### **Biological Source**

Neem consists of the leaves and other useful parts of *Azadirachta indica* A. Juss., belonging to the family *Meliaceae*. The leaves are commonly used for medicinal and pharmaceutical investigations.

### **Chemical Constituents**

Neem contains several biologically active constituents, including:

- Azadirachtin
- Nimbin
- Nimbidin
- Salannin
- Gedunin
- Quercetin
- Tannins
- Flavonoids
- Phenolic compounds

### **3.2 *Murraya koenigii* (L.) Spreng. (Curry Leaf)**

#### **Biological Source**

Curry leaf consists mainly of the fresh or dried leaves of *Murraya koenigii* (L.) Spreng., belonging to the family *Rutaceae*.



**Figure 2: *Murraya koenigii* (L.) Spreng. (Curry Leaf)**

#### **Chemical Constituents**

The leaves contain various bioactive constituents, including:

- Carbazole alkaloids
- Flavonoids
- Phenolic compounds
- Tannins
- Essential oils
- Terpenoids
- Glycosides

#### **Uses**

Curry leaves are used in:

- Traditional medicinal preparations
- Digestive remedies
- Herbal formulations
- Antioxidant preparations
- Food and nutritional preparations
- Personal-care and herbal products

### 3.3 *Psidium guajava* L. (Guava)

#### **Biological Source**

Guava consists mainly of the leaves and other useful parts of *Psidium guajava* L., belonging to the family *Myrtaceae*. Guava leaves are particularly important in traditional medicine and phytochemical investigations

#### **Chemical Constituents**

Guava leaves contain several important phytoconstituents, including:

- Quercetin
- Flavonoids
- Tannins
- Phenolic compounds
- Terpenoids
- Saponins
- Essential oils
- Carotenoids



**Figure 3: *Psidium guajava* (Guava) Leafs**

#### **Uses**

Guava leaves are traditionally used in:

- Herbal preparations
- Oral and dental hygiene preparations
- Management of gastrointestinal disorders
- Herbal antimicrobial preparations
- Antioxidant formulations

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## **4. Materials and Methods:**

#### **Collection and Preparation of Plant Material**

Leaves of *Azadirachta indica*, *Murraya koenigii* and *Psidium guajava* were selected for the study. The collected leaves were cleaned to remove unwanted material and washed properly. The plant materials were shade-dried and subsequently powdered. The dried powders were passed through a sieve and stored appropriately until extraction.

#### **Preparation of Extract**

A suitable quantity of powdered plant material was subjected to extraction using ethanol or another suitable solvent. After extraction, the liquid portion was filtered and concentrated to obtain the crude extract. The dried extracts were stored for further analysis. Percentage yield was calculated using the ratio between the weight of dried extract and the initial weight of powdered plant material.

#### **Preliminary Phytochemical Screening**

The prepared extracts were screened for major classes of phytochemicals, including alkaloids, flavonoids, tannins, phenolics, saponins, terpenoids, glycosides, carbohydrates and proteins. The results were recorded as positive (+) or negative (–).

### Antibacterial Activity

The antibacterial activity was evaluated by the agar well diffusion method. Standardized bacterial inoculum was introduced onto the appropriate agar medium. Wells were prepared in the inoculated agar and different concentrations of plant extracts were added. Extract concentrations of 25, 50, 75 and 100 mg/mL were evaluated. A standard antibacterial agent was included for comparison, while the respective solvent served as control. Following incubation, the diameter of the inhibition zones was measured.

## 5. Results:

### Percentage Yield of Extracts

The reported extraction yields were 12.4% for *Azadirachta indica*, 10.8% for *Murraya koenigii* and 13.6% for *Psidium guajava*. Thus, Guava showed the highest reported extract yield among the three selected plants.

| Plant                     | Powder Used | Extract Obtained | Percentage Yield |
|---------------------------|-------------|------------------|------------------|
| <i>Azadirachta indica</i> | 100 g       | 12.4 g           | 12.4%            |
| <i>Murraya koenigii</i>   | 100 g       | 10.8 g           | 10.8%            |
| <i>Psidium guajava</i>    | 100 g       | 13.6 g           | 13.6%            |

### Phytochemical Screening

The extracts of all three plants showed positive reactions for alkaloids, flavonoids, tannins, phenolics, saponins, terpenoids, glycosides and carbohydrates. Protein was reported as absent in Neem and Curry leaf extracts but present in Guava extract.

| Phytoconstituent | Neem | Curry Leaf | Guava |
|------------------|------|------------|-------|
| Alkaloids        | +    | +          | +     |
| Flavonoids       | +    | +          | +     |
| Tannins          | +    | +          | +     |
| Phenolics        | +    | +          | +     |
| Saponins         | +    | +          | +     |
| Terpenoids       | +    | +          | +     |
| Glycosides       | +    | +          | +     |
| Carbohydrates    | +    | +          | +     |
| Proteins         | –    | –          | +     |

### Antibacterial Activity

The reported observations showed increasing inhibition with increasing extract concentration. Against *S. aureus*, Neem produced inhibition zones ranging from  $8.2 \pm 0.4$  mm at 25 mg/mL to  $15.1 \pm 0.5$  mm at 100 mg/mL. Curry leaf showed values from  $7.6 \pm 0.5$  to  $13.9 \pm 0.4$  mm, whereas Guava showed the highest range, from  $9.1 \pm 0.4$  to  $16.3 \pm 0.5$  mm.

A similar concentration-related pattern was reported against *E. coli*. Neem showed inhibition from  $7.8 \pm 0.4$  to  $14.5 \pm 0.5$  mm, Curry leaf from  $7.2 \pm 0.4$  to  $13.2 \pm 0.5$  mm and Guava from  $8.6 \pm 0.5$  to  $15.7 \pm 0.4$  mm. The standard antibacterial agent showed inhibition zones of  $22.4 \pm 0.5$  mm against *S. aureus* and  $21.8 \pm 0.4$  mm against *E. coli*.

## Discussion

The reported observations indicate that all three selected medicinal plants exhibited antibacterial activity against both tested bacterial strains. The increase in inhibition zone with increasing extract concentration suggests a concentration-dependent antibacterial response in the reported dataset. Among the investigated extracts, *Psidium guajava* produced the largest inhibition zones against both *S. aureus* and *E. coli*. Neem showed intermediate activity, while Curry leaf demonstrated comparatively lower inhibition under the reported conditions.

The antibacterial response may be associated with the presence of several phytochemical groups detected during preliminary screening. Phenolics, flavonoids, tannins, terpenoids and other secondary metabolites may contribute to antimicrobial effects through different mechanisms. However, the present phytochemical screening only establishes their preliminary presence and does not identify the individual compounds responsible for the observed activity.

The reported results also demonstrate that the plant extracts were less active than the standard antibacterial agent under the stated experimental conditions. Further investigations involving different extraction solvents, purified constituents, minimum inhibitory concentration studies and additional bacterial strains would be useful for detailed evaluation.

Herbal nail paint is a nail cosmetic preparation containing one or more plant-derived ingredients in a suitable formulation base. The herbal ingredient may be incorporated in the form of a plant extract, gel or other suitable botanical preparation. Depending on the selected ingredient, herbal nail paint may provide conditioning, moisturizing, protective or antioxidant benefits in addition to its cosmetic function [6].

The performance of herbal nail paint depends on the appropriate selection and concentration of the herbal ingredient and other formulation components. Excessive incorporation of herbal material may influence viscosity, drying time, colour, film formation and stability. Therefore, formulation optimization is necessary to obtain satisfactory cosmetic characteristics.

## 6. Conclusion:

The reported data demonstrate antibacterial activity of *Azadirachta indica*, *Murraya koenigii* and *Psidium guajava* leaf extracts against *Staphylococcus aureus* and *Escherichia coli*. The activity increased with extract concentration, with *Psidium guajava* showing the highest reported inhibition, followed

by *Azadirachta indica* and *Murraya koenigii*. Preliminary phytochemical screening indicated the presence of several potentially bioactive constituent groups. These findings support further investigation of the selected plants as potential sources of antibacterial compounds.

*Note:* The numerical antibacterial observations above are reproduced from the supplied project file, where they are described as illustrative observations. They should be replaced with actual laboratory observations before using the paper as a report of completed experimental research.

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