

COMPARATIVE ANALYSIS OF IN-VITRO ANTIBACTERIAL ACTIVITY OF SOLANUM TRILOBATUM LEAF EXTRACT WITH GENTAMICIN

M. Kavitha*¹, C. Joshuva², S. Kalaiyarasi³, B. Kashif Khamar⁴

^{1,2,3}Student, Department of Pharmacology, Sri Vijay Vidyalaya College of Pharmacy, Dharmapuri, Tamil Nadu, India

⁴Mentor, Department of Pharmacology, Sri Vijay Vidyalaya College of Pharmacy, Dharmapuri, Tamil Nadu, India

Abstract - *Solanum trilobatum* Linn. is a medicinal plant traditionally used for various ailments and is reported to possess several pharmacological activities. The present study was carried out to evaluate the in-vitro antibacterial activity of the ethanolic leaf extract of *Solanum trilobatum* against selected bacterial pathogens. The leaves were collected, authenticated, dried, powdered and extracted with ethanol. The extract was subjected to preliminary phytochemical screening and tested for antibacterial activity by the agar well diffusion method against *Staphylococcus aureus*, *Streptococcus pyogenes*, *Klebsiella* sp. and *Escherichia coli*. Different concentrations of the extract (5, 10, 15 and 20 μ L) were tested, with gentamicin used as the standard. The extract showed antibacterial activity against the tested organisms, with the highest zone of inhibition of 19 mm against *E. coli* at 20 μ L. The results indicate that the ethanolic leaf extract of *S. trilobatum* possesses promising preliminary antibacterial activity and may be a potential source of antibacterial phytoconstituents. Further studies are required to identify the active constituents and confirm their antibacterial potential.

Key Words: *Solanum trilobatum*, ethanolic extract, antibacterial activity, phytochemical screening, gentamicin.

1. INTRODUCTION

Antimicrobial resistance (AMR) has emerged as one of the major challenges to effective treatment of bacterial infections worldwide. The progressive emergence and dissemination of bacteria that are resistant to commonly used antimicrobial agents can compromise the management of infectious diseases and increase the risk of treatment failure, prolonged illness and healthcare burden. The World Health Organization has identified antimicrobial resistance as a major global public-health threat and has emphasized the need for research and development of new approaches to prevent and treat infections caused by resistant microorganisms. Consequently, the identification of new antibacterial substances with novel or complementary mechanisms of action has become an important area of pharmaceutical and biomedical research [1,2].

Medicinal plants have attracted considerable scientific interest as potential sources of biologically active compounds. Plants synthesize a diverse range of secondary metabolites, including alkaloids, phenolic compounds, flavonoids, tannins, saponins and terpenoids, many of which have been associated with antimicrobial properties. Plant-derived compounds and extracts may interfere with bacterial growth through several mechanisms, including alteration of cell-membrane integrity, interaction with cellular proteins, interference with nucleic-acid synthesis and modulation of essential metabolic processes. The antibacterial activity of plant preparations, however, depends on several factors, including plant species, geographical origin, plant part, extraction solvent, extraction conditions, phytochemical composition and the susceptibility of the test microorganism [3]. Therefore, systematic evaluation of medicinal plant extracts under controlled experimental conditions remains important for identifying promising sources of antibacterial agents.

Solanum trilobatum Linn., belonging to the family Solanaceae, is a medicinal plant traditionally used in South Indian systems of medicine. Commonly known as Thuthuvalai, the plant is a prickly perennial climbing shrub characterized by lobed leaves and bluish-purple flowers. Different parts of the plant, particularly the leaves, have been traditionally associated with the management of respiratory complaints such as cough, cold

and asthma. The plant has also attracted pharmacological interest because of its reported antimicrobial, antioxidant, anti-inflammatory and other biological activities. The traditional importance of *S. trilobatum*, together with its diverse phytochemical composition, provides a rationale for continued scientific investigation of its pharmacological potential. Steroidal alkaloids, flavonoids, tannins, saponins and terpenoids are among the major phytochemical groups reported for the plant.

Phytochemical constituents are considered important contributors to the biological activities of medicinal plants. Alkaloids may exert antimicrobial effects through interactions with cellular targets, whereas phenolic compounds and flavonoids may influence bacterial membranes, enzymes, nucleic acids and other cellular processes. Tannins can interact with proteins and microbial cell structures, while saponins possess amphiphilic properties that may influence membrane permeability. The antibacterial effects of these constituents are often dependent on their chemical structures, concentrations and interactions with other constituents present in the plant extract [3]. The presence of these phytochemical groups in *S. trilobatum* therefore provides a plausible basis for investigating its antibacterial activity, although preliminary phytochemical screening alone cannot establish which individual compounds are responsible for the observed effect.

Previous experimental investigations have reported antibacterial activity associated with different extracts and phytochemical fractions of *S. trilobatum* against several bacterial pathogens, including *Staphylococcus aureus*, *Bacillus subtilis*, *Streptococcus pyogenes*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. The reported activity has also varied according to the extraction solvent, concentration and bacterial species. Investigations of specific phytochemical fractions have further suggested that compounds such as saponins and tannins may contribute to the antibacterial properties of *S. trilobatum*. These observations indicate that the antibacterial potential of the plant may be associated with a combination of bioactive constituents rather than a single compound.

The choice of extraction solvent is particularly important in phytochemical and pharmacological investigations because solvents of different polarity can extract different groups of plant constituents. Ethanol is frequently used for the preparation of medicinal plant extracts because it can recover a broad range of polar and moderately non-polar phytochemicals. Differences in extraction procedures can consequently produce differences in phytochemical composition and biological activity. The present study therefore employed an ethanolic extraction of *S. trilobatum* leaves followed by preliminary phytochemical screening and antibacterial evaluation.

In-vitro diffusion assays provide a preliminary approach for evaluating the antibacterial potential of plant extracts. In the present investigation, the agar well diffusion method was employed using Mueller-Hinton agar. The antibacterial activity of the ethanolic leaf extract was evaluated against *S. aureus*, *S. pyogenes*, *Klebsiella* sp. and *E. coli* at different extract concentrations, and gentamicin was used as the reference antibacterial agent. Measurement of the zone of inhibition provides an initial indication of bacterial growth inhibition; however, the magnitude of a diffusion zone can also be influenced by factors such as extract concentration, compound diffusion, molecular characteristics and experimental conditions. Therefore, the findings should be interpreted as evidence of in-vitro antibacterial activity rather than clinical efficacy [3].

Therefore, the present study was undertaken to investigate the in-vitro antibacterial activity of an ethanolic leaf extract of *Solanum trilobatum* Linn. against selected bacterial pathogens using the agar well diffusion method and to compare the observed antibacterial activity with gentamicin as a standard antibacterial agent. The study also aimed to evaluate the preliminary phytochemical constituents present in the ethanolic leaf extract and to assess the variation in antibacterial activity at different extract concentrations.

2. MATERIALS AND METHODS

2.1 Collection and Authentication of Plant Material

The leaves of *Solanum trilobatum* Linn. were collected and authenticated based on their morphological characteristics. The collected leaves were separated, thoroughly cleaned to remove adhering foreign materials,

dried under suitable conditions and powdered using a mechanical grinder. The powdered material was stored in a clean, dry and airtight container until further extraction.

2.2 Preparation of Leaf Extract

Two solvents were used for extraction of the *Solanum trilobatum* leaf powder: (i) ethanol and (ii) water.

Ethanol:

- Ethanol is a clear, colourless, volatile liquid with a characteristic alcoholic odour and a molecular formula of C_2H_5OH .
- It has a boiling point of approximately $78^\circ C$ and is highly flammable.
- It is miscible with water and many organic solvents owing to its polar nature.
- In pharmaceutical research, ethanol is commonly used as a solvent for the extraction of phytochemicals.

Water:

- Water acts as a solvent for extraction owing to its polarity, ability to dissolve a wide range of substances, hydrogen-bonding capability, high dielectric constant, safety and availability.
- Its polar nature allows it to dissolve polar and ionic compounds by attracting and dispersing solute molecules.
- Its ability to form hydrogen bonds enhances the solubility of certain compounds, and its high dielectric constant enables the dissolution of ionic compounds.
- Additionally, water is non-toxic, non-flammable, inexpensive and widely available, making it a preferred solvent in various industries.

2.3 Extraction Details

- Plant material: Dried powdered leaves of *Solanum trilobatum*
- Quantity: 20 g
- Solvent: Ethanol + distilled water
- Ethanol: 180 mL; Distilled water: 20 mL; Total solvent: 200 mL
- Solvent ratio: 90:10 (v/v)
- Method: Soxhlet extraction
- Final product: Concentrated hydroalcoholic extract of *Solanum trilobatum*



Fig. 1: Soxhlet Extraction of *Solanum trilobatum* Leaf Powder

2.4 Preliminary Phytochemical Screening

The concentrated ethanolic leaf extract of *Solanum trilobatum* was subjected to standard qualitative phytochemical tests to detect the presence of alkaloids, flavonoids, phenolic compounds, tannins, saponins, terpenoids, steroids, glycosides, carbohydrates, proteins, reducing sugars and anthraquinones. The results are summarized in Table 1.

Table 1: Preliminary Phytochemical Screening of Ethanolic Leaf Extract

S. No.	Phytochemical	Test	Observation	Result
1	Alkaloids	Dragendorff's test	Orange/reddish-brown precipitate	Present (+)
2	Flavonoids	Shinoda test	Pink/red coloration	Present (+)
3	Phenolic compounds	Ferric chloride test	Blue/green coloration	Present (+)
4	Tannins	Ferric chloride test	Blue-black/green coloration	Present (+)
5	Saponins	Foam test	Persistent froth formation	Present (+)
6	Terpenoids	Salkowski test	Reddish-brown coloration at interface	Present (+)
7	Steroids	Liebermann–Burchard test	Green/bluish-green coloration	Present (+)
8	Glycosides	Keller–Killiani test	Brown ring at interface	Present (+)
9	Carbohydrates	Molisch's test	Violet/purple ring	Present (+)
10	Proteins	Biuret test	Violet/purple coloration	Present (+)
11	Reducing sugars	Fehling's test	Brick-red precipitate	Present (+)
12	Anthraquinones	Bornträger's test	Pink/red coloration in alkaline layer	Absent (–)

2.5 Preparation of Bacterial Inoculum

The selected bacterial cultures (*Staphylococcus aureus*, *Streptococcus pyogenes*, *Klebsiella* sp. and *Escherichia coli*) were sub-cultured on suitable nutrient medium. Fresh bacterial colonies were suspended in sterile normal saline and the turbidity was adjusted to approximately 0.5 McFarland standard, corresponding to about 1×10^8 CFU/mL. The standardized bacterial suspension was used to inoculate the surface of Mueller-Hinton agar (MHA) plates uniformly using a sterile cotton swab.

2.6 Agar Well Diffusion Method

The antibacterial activity of the ethanolic leaf extract was evaluated by the agar well diffusion method. The parameters used are summarized below.

- Medium: Mueller-Hinton Agar (MHA)
- Test organisms: *S. aureus*, *S. pyogenes*, *Klebsiella* sp., and *E. coli*
- Extract concentrations: 5, 10, 15 and 20 μ L
- Standard: Gentamicin, 20 μ L
- Incubation: 37°C for 18–24 hours
- Measurement: Diameter of the zone of inhibition, in mm

3. RESULTS

Preliminary phytochemical screening of the ethanolic leaf extract of *Solanum trilobatum* demonstrated the presence of alkaloids, flavonoids, phenolic compounds, tannins, saponins, terpenoids, steroids, glycosides, carbohydrates, proteins and reducing sugars, while anthraquinones were found to be absent (Table 1).

The antibacterial assay demonstrated variable inhibitory activity of the ethanolic leaf extract against the selected bacterial pathogens. The maximum zone of inhibition produced by the extract was 19 mm against *E. coli* at 20 μ L, followed by 18 mm against *S. aureus* and 17 mm against *Klebsiella* sp. Comparatively lower activity was observed against *S. pyogenes*, which remained at 6 mm across all tested concentrations. Gentamicin produced greater inhibition against all four organisms under the experimental conditions used. The zone-of-inhibition values recorded at each concentration are summarized in Table 2.

Table 2: Zone of Inhibition (mm) of Ethanolic Leaf Extract of *S. trilobatum* Against Test Organisms

Organism	A (05 μ L)	B (10 μ L)	C (15 μ L)	D (20 μ L)	S-Standard
Sa	06mm	09mm	13mm	18mm	28mm
St	06mm	06mm	06mm	06mm	29mm
Kleb	09mm	11mm	16mm	17mm	26mm
EC	06mm	06mm	11mm	19mm	26mm

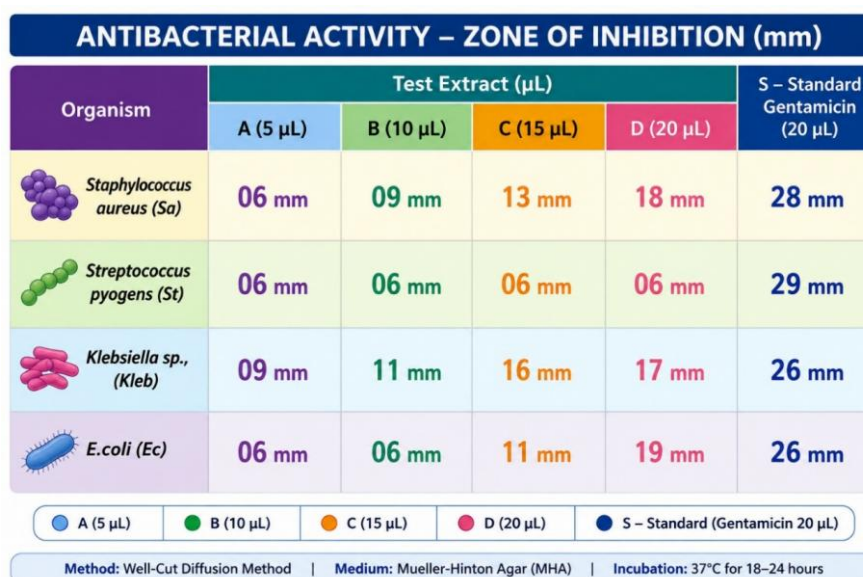


Fig. 2: Zone of Inhibition Produced by the Ethanolic Leaf Extract at Different Concentrations Compared with Gentamicin

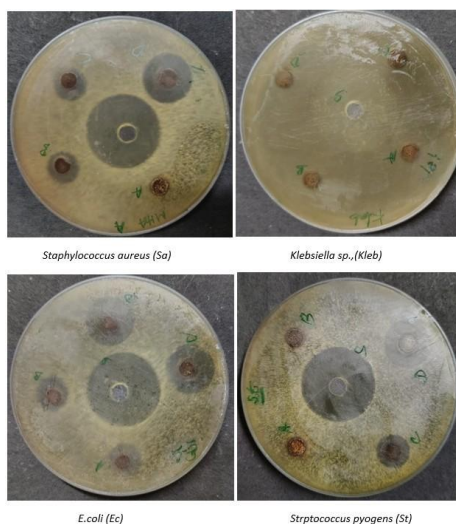


Fig. 3: Agar Well Diffusion Plates Showing Zones of Inhibition Against *S. aureus*, *Klebsiella* sp., *E. coli* and *S. pyogenes*

4. CONCLUSION

The present study demonstrated that the ethanolic extract of *Solanum trilobatum* leaves exhibited antibacterial activity against the tested bacterial pathogens using the agar well diffusion method. The activity varied with the bacterial strain and extract concentration. The highest zone of inhibition was observed against *E. coli* (19 mm) at 20 μ L, followed by *S. aureus* (18 mm) and *Klebsiella* sp. (17 mm). The activity against *S. pyogenes* was comparatively low (6 mm). Gentamicin showed higher antibacterial activity than the test extract against all organisms.

Overall, the findings suggest that *Solanum trilobatum* may possess promising antibacterial potential, particularly against *E. coli*, *S. aureus* and *Klebsiella* sp., and may warrant further investigation to identify and characterize its active antibacterial constituents.

REFERENCES

- [1] Govindarajan P, Chinnachamy C. Phytochemical and therapeutic evaluation of leaf and in vitro derived callus and shoot of *Solanum trilobatum*. Pak J Pharm Sci. 2014;27(6 Suppl):2101-2107.
- [2] Megala S, Paranthaman SR, Poonguzhali P, Saranraj P, et al. Evaluation of antibacterial activity and bioactive compounds in *Solanum trilobatum* extracts. 2025.
- [3] Gentamicin. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2026 Aug 8].
- [4] Gentamicin injection, solution [prescribing information]. DailyMed. Updated January 29, 2026 [cited 2026 Aug 8].