International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 14 Issue 5, May-2025

Phytochemical Screening and Antimicrobial Activity of Solanum Nigrum Leaf Extract

Gunjan Yadav[1], Renu Verma[2], R. Sujatha[3]

[1,2,3]Faculty of Engineering and Technology, Rama University, Kanpur

*Corresponding Author's Mail: renuverma.fet@ramauniversity.ac.in

ABSTRACT

***Solanum nigrum* (black nightshade) is a well-known medicinal plant traditionally used to treat various ailments. The present study investigates the phytochemical constituents and evaluates the antimicrobial properties of methanolic leaf extracts of Solanum nigrum against Escherichia coli and Staphylococcus aureus. Preliminary phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, saponins, phenolics, and terpenoids. The antimicrobial activity was assessed using the agar well diffusion method. The results indicated a concentration-dependent inhibitory effect of the extract on the tested bacterial strains. Furthermore, GC-MS analysis revealed several bioactive compounds that might be responsible for the observed antimicrobial activity.**

INTRODUCTION

Medicinal plants have been used for centuries as a rich source of therapeutic agents. Among these, Solanum nigrum holds a prominent position due to its diverse pharmacological activities, including anti-inflammatory, antioxidant, anticancer, and antimicrobial properties. Belonging to the family Solanaceae, S. nigrum is commonly known as black nightshade and is widely distributed in tropical and subtropical regions.

The increasing resistance of pathogenic microorganisms to synthetic antibiotics has necessitated the search for alternative therapeutic agents. Natural products, especially those derived from plants, offer promising avenues for the development of novel antimicrobial compounds. This study aims to explore the phytochemical composition and antimicrobial efficacy of Solanum nigrum leaf extracts, particularly targeting two clinically significant bacteria: E. coli (Gram-negative) and S. aureus (Gram-positive).

MATERIALS AND METHODS

Collection and Preparation of Plant Material

Fresh leaves of Solanum nigrum were collected from local agricultural fields, washed thoroughly with distilled water, and shade dried for two weeks. The dried leaves were ground into a fine powder using a mechanical grinder and stored in airtight containers.

Extraction Procedure

Approximately 50 grams of powdered leaf material were subjected to Soxhlet extraction using 250 mL of methanol. The extract was concentrated using a rotary evaporator and stored at 4°C until further use.

Phytochemical Screening

Preliminary phytochemical analysis was carried out using standard procedures to detect the presence of various secondary metabolites, including alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolics.

Antimicrobial Assay

The antimicrobial activity of the methanolic extract was tested using the agar well diffusion method. E. coli and S. aureus strains were obtained from a microbial culture collection. Nutrient agar plates were inoculated with the bacterial cultures, and wells were made using a sterile borer. Extracts at concentrations of 25, 50, and 100 mg/mL were added to the wells.

Ciprofloxacin was used as the positive control, and methanol as the negative control. Plates were incubated at 37°C for 24 hours, and the zone of inhibition was measured.

GC-MS Analysis
The methanolic extract was subjected to Gas Chromatography-Mass Spectrometry (GC-MS) to identify the bioactive compounds present. The analysis was performed using a Shimadzu GC-MS system under standard conditions. The compounds were identified by comparing the mass spectra with NIST library data.

RESULTS

Phytochemical Analysis
The preliminary screening confirmed the presence of multiple phytoconstituents as shown in Table 1.

Table 1: Multiple phytoconstituents in the leaf extract

Compound Class	Presence
Alkaloids	+
Flavonoids	+
Tannins	+
Saponins	+
Phenolics	+
Terpenoids	+

Antimicrobial Activity
The methanolic leaf extract showed significant antimicrobial activity against both E. coli and S. aureus. The zone of inhibition increased with extract concentration. At 100 mg/mL, the extract exhibited inhibition zones of 16 mm for E. coli and 18 mm for S. aureus, as shown in Table 2.

Table: 2 The leaf extract showed significant antimicrobial activity

Concentration (mg/mL)	Zone of Inhibition (mm) – E. coli	Zone of Inhibition (mm) – S. aureus
25	8	10
50	12	14
100	16	18
Ciprofloxacin (10 µg)	22	24

GC-MS Analysis
The GC-MS analysis revealed the presence of several bioactive compounds, including phytol, hexadecanoic acid, squalene, and β-sitosterol, known for their antimicrobial and antioxidant activities.

DISCUSSION

The phytochemical screening of Solanum nigrum leaves indicates the presence of various bioactive compounds with potential medicinal properties. Flavonoids and phenolics are well-known for their antimicrobial and antioxidant effects, while alkaloids often possess strong pharmacological activity. The antimicrobial results suggest that S. nigrum leaf extract is more effective against Gram-positive S. aureus than Gram-negative E. coli. This is consistent with other studies which show that Gram-negative bacteria, due to their outer membrane, are generally more resistant to plant extracts. The bioactive compounds identified through GC-MS, such as phytol and squalene, have documented antimicrobial properties, supporting the results observed in the antimicrobial assay.

CONCLUSION

The study demonstrates that Solanum nigrum methanolic leaf extract contains several phytochemicals with notable antimicrobial activity, particularly against S. aureus and E. coli. The findings highlight the potential of this plant as a source

of natural antimicrobial agents. Further studies, including purification and characterization of individual compounds and in vivo testing, are recommended to validate its clinical applicability.

REFERENCES

[1]. Cowan, M.M. (1999). Plant products as antimicrobial agents. *Clinical Microbiology Reviews*, 12(4), 564–582. https://doi.org/10.1128/CMR.12.4.564
[2]. Doughari, J.H., & Okafor, B. (2007). Antibacterial activity of *Solanum nigrum* Linn. leaf extracts. *African Journal of Biotechnology*, 6(14), 1674–1677.
[3]. Harborne, J.B. (1998). *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis* (3rd ed.). Chapman and Hall, London.
[4]. Kokate, C.K., Purohit, A.P., & Gokhale, S.B. (2008). *Pharmacognosy* (45th ed.). Nirali Prakashan, Pune.
[5]. Nwankwo, I.U., & Nwosu, M.O. (2020). Phytochemical screening and antibacterial activity of *Solanum nigrum* leaf extracts. *Journal of Medicinal Plants Research*, 14(5), 240–246.
[6]. Prashanth, K.N., Neelagund, S.E., & Krishna, V. (2011). Antibacterial activity of *Solanum nigrum* extracts against clinical pathogens. *International Journal of Pharmacy and Pharmaceutical Sciences*, 3(4), 437–440.
[7]. Sofowora, A. (1993). *Medicinal Plants and Traditional Medicine in Africa* (2nd ed.). Spectrum Books Ltd., Ibadan, Nigeria.
[8]. Srinivasan, D., Nathan, S., Suresh, T., &Perumalsamy, P.L. (2001). Antimicrobial activity of certain Indian medicinal plants used in folkloric medicine. *Journal of Ethnopharmacology*, 74(3), 217–220.
[9]. Trease, G.E., & Evans, W.C. (2002). *Pharmacognosy* (15th ed.). Saunders/Elsevier.
[10]. Parekh, J., & Chanda, S. (2007). In vitro antimicrobial activity and phytochemical analysis of some Indian medicinal plants. *Turkish Journal of Biology*, 31(1), 53–58.