



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Research Article

Phytochemical Screening and Antimicrobial Activity of a Topical Gel Formulated with *Adhatoda vasica* Leaf Extract

Kirti Burman*, Dr. Satish Nayak, Smita Jain

Bansal College of Pharmacy, Kokta, Anand Nagar, Bhopal, Madhya Pradesh, India 462021

ARTICLE INFO

Published: 08 Jul. 2025

Keywords:

Adhatoda vasica (Vasaka),
bioactive compounds,
antimicrobial activity,
antibiotic resistance,
antimicrobial resistance
(AMR), vasicine, vasicinone

DOI:

10.5281/zenodo.15833563

ABSTRACT

The present study focuses on the formulation and evaluation of a topical herbal gel incorporating *Adhatoda vasica* (Vasaka) leaf extract, aiming to explore its phytochemical composition and antimicrobial potential. *Adhatoda vasica*, a well-documented medicinal plant known for its respiratory and antimicrobial properties, was selected for the development of a bioactive topical formulation. Fresh and partially dried leaves of *A. vasica* were collected, and extraction was performed using Dimethyl Sulfoxide (DMSO) in a 1:10 w/v ratio to ensure efficient extraction of phytoconstituents, particularly alkaloids such as vasicine and vasicinone. The phytochemical screening of the extract confirmed the presence of bioactive compounds including alkaloids, flavonoids, tannins, phenolics, saponins, and glycosides, which are known to contribute to antimicrobial and therapeutic effects. The purified extract was then incorporated into a gel base using carbopol 940 as a gelling agent along with glycerine, triethanolamine, and distilled water to achieve optimal consistency and stability. The formulated gel was subjected to various physicochemical evaluations such as appearance, homogeneity, spreadability, pH, and stability testing. The gel displayed a yellowish appearance with a smooth texture and acceptable spreadability, indicating good user applicability. Its pH was found to be within the dermatologically acceptable range, and no phase separation or degradation was observed over the testing period, demonstrating the formulation's physical stability. Further, antimicrobial activity of the gel was tested against common bacterial strains including *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* using agar well diffusion method. The results exhibited notable zones of inhibition, thereby confirming the antimicrobial efficacy of the formulation, which can be attributed to the alkaloid-rich profile of the plant extract. Quantitative analysis revealed vasicine purity at 92.61% and vasicinone at 96.35%, ensuring the extract's potency.

*Corresponding Author: Kirti Burman

Address: Bansal College of Pharmacy, Kokta, Anand Nagar, Bhopal, Madhya Pradesh, India 462021

Email ✉: ganugavade123@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



INTRODUCTION

Plants have historically served as a reservoir of bioactive compounds with diverse pharmacological properties, including antimicrobial activity. The increasing prevalence of antibiotic resistance worldwide has driven a growing interest in plant-based alternatives as potential antimicrobial agents. Antimicrobial resistance (AMR) is a growing global health concern where microorganisms, including bacteria, fungi, viruses, and parasites, evolve to withstand antimicrobial treatments, rendering conventional drugs ineffective. Incorporating natural products into antimicrobial strategies could provide sustainable and effective solutions to the AMR crisis. Future research should focus on identifying novel bioactive compounds, understanding their mechanisms of action, and developing innovative formulations to maximize their therapeutic potential.

ADHATODA VASICA

Adhatoda vasica (commonly known as Malabar Nut), a medicinal plant extensively used in traditional systems of medicine like Ayurveda, holds considerable promise due to its rich phytochemical profile. The leaves of *Adhatoda vasica* are known to contain active constituents such as vasicine, vasicinone, and other alkaloids, which have demonstrated a wide range of biological activities, including anti-inflammatory, antioxidant, and antimicrobial effects. **Adhatoda vasica** Nees, commonly known as **Malabar Nut** or **Vasaka**, is a perennial evergreen shrub from the family **Acanthaceae**, widely valued in traditional medicine. Growing up to 2–3 meters tall, it features simple, lanceolate leaves with a distinctive aroma and dense clusters of white or purple tubular flowers. Rich in alkaloids like vasicine and vasicinone, the plant is renowned for its therapeutic applications in Ayurveda, Unani,

and Siddha systems, particularly for treating respiratory ailments, fevers, and microbial infections. Known by various regional names such as "Adusa" in Hindi, "Vasaka" in Sanskrit, "Adathodai" in Tamil, and "Adulsa" in Marathi, *Adhatoda vasica* holds a prominent place in the ethnomedicinal heritage of South Asia.



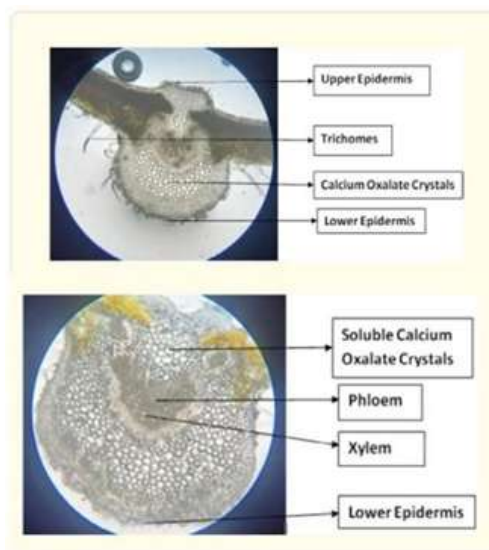
Morphology

The leaves of *Adhatoda vasica* are simple, opposite, and decussate in arrangement, with a lanceolate shape measuring approximately 10–15 cm in length and 3–5 cm in width. They exhibit a dark green coloration on the adaxial (upper) surface and a lighter green shade on the abaxial (lower) surface. The leaf margins are entire or slightly wavy, with an acuminate apex and an acute to slightly rounded base. Venation is pinnate, featuring a prominent midrib and clearly visible secondary veins. The texture is smooth and leathery, with a characteristic aromatic odor and a distinctly bitter taste.



Microscopy of leaves

The section clearly shows the upper and lower epidermis, both forming the outermost protective layers of the leaf. The trichomes, which are hair-like structures primarily found on the lower epidermis, are visible and play a role in protection and reducing water loss. Prominently, calcium oxalate crystals appear as rounded inclusions within the mesophyll, serving as diagnostic markers for the plant and possibly acting as a defense mechanism against herbivory. The internal vascular structure of the leaf is more visible. It shows the xylem and phloem, which form part of the collateral vascular bundle—xylem responsible for water transport and phloem for nutrient distribution. Surrounding this bundle, soluble calcium oxalate crystals are again observed, dispersed within the mesophyll tissue. The lower epidermis remains intact, indicating a well-preserved transverse cut.



Extraction

Fresh leaves of *Adhatoda vasica* were collected for extraction, and if dried leaves were used, they were finely powdered using a mortar and pestle or a mechanical grinder. A measured quantity of 100 grams of dried leaf powder was used for the

extraction process. The powdered material was placed in a clean flask, and Dimethyl Sulfoxide (DMSO) was added in a 1:10 ratio (100 g powder to 1000 mL DMSO). The mixture was stirred continuously for 24–48 hours at room temperature or agitated on a mechanical shaker to enhance extraction. Alternatively, a water bath maintained at 40°C–50°C was used to gently heat the mixture, ensuring efficient solubilization of phytoconstituents without degrading the solvent. After the extraction period, the mixture was filtered using filter paper or muslin cloth to separate the leaf residue, yielding a clear liquid extract rich in bioactive compounds, primarily alkaloids, dissolved in DMSO.

Phytochemical testing

The micro-chemical analysis of the *Adhatoda vasica* leaf extract confirmed the presence of alkaloids as the primary class of secondary metabolites. All four classical tests for alkaloids—Dragendorff's, Mayer's, Wagner's, and Hager's—gave positive results, indicating a strong presence of alkaloid compounds such as vasicine and vasicinone, which are known for their therapeutic and antimicrobial properties. In contrast, tests for other classes of phytoconstituents, including flavonoids, phenolics/tannins, glycosides, steroids/terpenoids, and anthraquinones, showed negative results. Except for a slight positive response in the Shinoda Test for flavonoids, no other confirmatory reactions were observed for these groups. These results highlight that the bioactivity of the extract is predominantly due to its alkaloid content, supporting the plant's traditional use in treating respiratory and microbial conditions. The absence of other major secondary metabolites simplifies the phytochemical profile, making *Adhatoda vasica* an ideal candidate for focused studies on alkaloid-based formulations.

Formulation of antimicrobial gel



The herbal gel was formulated using Carbopol 934 as the gelling agent. Initially, 0.8 g of Carbopol was gradually dispersed in 89.4 g of distilled water with continuous stirring and left to hydrate for 2 hours. Glycerin (5.0 g) was then added as a humectant to improve the gel's consistency. Following this, 2.0 g of *Adhatoda vasica* extract was incorporated into the base with constant stirring to ensure uniform distribution. To enhance the therapeutic efficacy and skin benefits, 2.0 g of aloe vera gel and 0.5 g of neem oil were added sequentially and blended thoroughly. The pH of the gel was adjusted using 0.3 g of triethanolamine (TEA), added dropwise while stirring to achieve optimal stability and skin compatibility. Finally, the mixture was homogenized to form a clear, smooth gel, which was then transferred to a clean container and stored in a cool, dry place away from sunlight.



Evaluation of antimicrobial gel

The formulated herbal gel was subjected to a series of physicochemical and biological evaluations to assess its quality, stability, and efficacy. The micro chemical test and phytochemical screening confirmed the presence of alkaloids, indicating successful incorporation of active plant constituents. The alkaloid content was found to be 5.69 mg/ml, with high purity levels of vasicine (92.61%) and vasicinone (96.35%), which are known for their therapeutic properties.

Antimicrobial testing revealed clear zones of inhibition around the alkaloid extract wells, with no growth of *E. coli*, *S. aureus*, or *Candida albicans*, indicating strong antimicrobial activity. The gel showed good organoleptic properties, appearing off-white with a slight yellow tint and a compliant odour. The pH value of 6.87 was within the skin-friendly range, ensuring safety for topical use. Physicochemical tests demonstrated good spreadability and a viscosity of 42654.7 cps, indicating appropriate consistency and ease of application. Overall, the test results confirmed that the herbal gel is stable, bioactive, and suitable for dermatological use, with potential applications in antimicrobial and therapeutic skin treatments.

CONCLUSION

The study successfully demonstrated that *Adhatoda vasica*-based gel is a promising, stable, and effective herbal formulation with notable antimicrobial activity. The high content and purity of alkaloids, along with strong biological activity against pathogens and favorable physicochemical properties, highlight the gel's potential as a natural topical antimicrobial product. This research supports the further development and clinical evaluation of such formulations in herbal medicine, wound care, and dermatological applications, offering a safer, plant-based alternative to synthetic antimicrobials.

REFERENCES

1. "Common Names for Malabar Nut (*Justicia adhatoda*)". Encyclopedia of Life. Retrieved 3 January 2013.
2. Aslam, Mohd et.al (2013). "Adsorption of Hg (II) from Aqueous Solution Using *Adulsa* (*Justicia adhatoda*) Leaves Powder: Kinetic and Equilibrium Studies". *Journal of Chemistry*. 2013: 1–11. doi:10.1155/2013/174807. ISSN 2090-9063.

3. Jump up to: a b "Facts about for Malabar Nut which are not known (*Justicia adhatoda*)". Encyclopedia of Life. Retrieved 3 January 2013.
4. "*Justicia adhatoda* L." Plants of the World Online. Royal Botanic Gardens, Kew. Retrieved 2022-06-16.
5. M Iqbal Zuberi (2012). "Flora". In Sirajul Islam; Miah, Sajahan; Khanam, Mahfuza; Ahmed, Sabbir (eds.). *Banglapedia: the National Encyclopedia of Bangladesh* (Online ed.). Dhaka, Bangladesh: Banglapedia Trust, Asiatic Society of Bangladesh. ISBN 984-32-0576-6. OCLC 52727562. OL 30677644M. Retrieved 17 May 2025.
6. Kumar, M., et.al Anti-typhoid activity of *Adhatoda vasica* and *Vitex negundo* Persian Gulf Crop Protection, 2013; 2(3): 64 75
7. Zanasì, Alessandro et.al (2017). "A reappraisal of the mucoactive activity and clinical efficacy of bromhexine". *Multidisciplinary Respiratory Medicine*. 12: 7.
8. Shinwari ZK. Medicinal plants research in Pakistan. *Journal of medicinal plants research* 2010 Feb 4; 4(3): 16176.
9. Ved DK, et.al Demand and supply of medicinal plants in India. NMPB, New Delhi & FRLHT, Bangalore, India 2007; 18: 139-204.
10. Claeson UP, et.al *Adhatoda vasica*: a critical review of ethno pharmacological and toxicological data. *Journal of Ethnopharmacology* 2000 Sep 1; 72(1-2): 1-20.
11. Baquar SR. Medicinal and poisonous plants of Pakistan. *Medicinal and poisonous plants of Pakistan*; 1989. p. 515515.
12. P Singh T et.al *Adhatoda vasica* Nees: phytochemical and pharmacological profile. *The Natural Products Journal* 2011 Jul 1; 1(1): 29-39.

HOW TO CITE: Kirti Burman, Dr. Satish Nayak, Smita Jain, Phytochemical Screening and Antimicrobial Activity of a Topical Gel Formulated with *Adhatoda vasica* Leaf Extract, *Int. J. of Pharm. Sci.*, 2025, Vol 3, Issue 7, 935-939. <https://doi.org/10.5281/zenodo.15833563>

