

ANTIMICROBIAL STUDIES ON BHUMI AMLA (PHYLLANTHUS NIRURI)

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ABSTRACT

An international public health concern brought on by the abuse and overuse of antibiotics is antimicrobial resistance (AMR). It makes it harder to treat infections, which can result in fatalities, severe illness, and disability. Just 25% of the antibiotics on the market today have novel mechanisms against important diseases, indicating that antibiotic discovery is progressing slowly. Novel antibacterial chemicals may be developed from the secondary metabolites of traditional medicinal plants. Safe and efficient antibacterial chemotherapies can be developed using these substances, which frequently have potent antimicrobial action. In herbal medicine systems such as Traditional Chinese Medicine, Indian Ayurveda, and Indonesian Jamu, *P. niruri* has a long history. Among the conditions for which the entire plant is used as a treatment are dyspepsia, influenza, vaginitis, tumours, diabetes, diuretics, jaundice, kidney stones, and dysentery. In this study, *Phyllanthus Niruri* leaves were extracted using a variety of solvents, including petroleum ether, chloroform, acetone, ethanolic, and aqueous; physicochemical evaluation was determined; ash values were estimated; and phytochemical evaluation was conducted, involving the measurement of sugars, alkaloids, glycosides, tannins, flavonoids, steroids, proteins, and terpenes. The plant's water and ethanol extracts were made by the help of soxhlet apparatus, the solvent

extraction method. And its antibacterial activity against eleven clinical isolates was examined using the agar well diffusion method. This review highlights the present understanding of *P. niruri*'s antimicrobial capabilities, emphasising its phytochemical makeup, modes of action, and effectiveness against a variety of infections. It seeks to provide light on its possible use as a natural antibacterial.

Keywords: *Phyllanthus Niruri*, *Antimicrobial resistance*, *Agar well diffusion method*

Introduction

The Indian herb *Phyllanthus Niruri* is frequently seen as a winter weed in warmer climates.¹ In tropical and subtropical regions, it is a member of the *Phyllanthus* genus, which includes more than 600 species of trees, shrubs, and annual or biennial herbs.² A member of the Euphorbiaceae family, *Phyllanthus Niruri* normally reaches a height of 60 cm. Its name, *Phyllanthus*, means “leaf and flower,” referring to the way the fruit and bloom seem to blend into the leaf. Because of its hepatoprotective qualities, *Phyllanthus Niruri*, a common rainy season plant in wastelands and farmed areas, has attracted the interest of researchers.⁵ Antimicrobial resistance (AMR) occurs when certain common antibiotics lose their ability to affect bacteria, fungus, parasites, or viruses. Genetic material changes with time, causing AMR, a normal mechanism in infections.³ The overuse and abuse of antibiotics in plants, animals, and people has sped up the emergence of infections that are resistant to them. The inability to treat infections due to AMR causes severe disease and morbidities, disability, and even death. In fact, AMR is regarded by the World Health Organisation (WHO) as one of the most dangerous dangers to global public health, and it was directly responsible for 1.27 million deaths globally in 2019. According to the World Bank, AMR is expected to cost the healthcare system USD 1 trillion by 2050, posing a serious financial strain.⁶ It has long been known that traditional medicinal plants have antibacterial qualities. *Bhumi Amla*, or *Phyllanthus Niruri*, is a tropical plant that belongs to the Euphorbiaceae family. Recent research has demonstrated its promise against bacterial, fungal, and viral pathogens,

despite its traditional usage in treating liver ailments, urinary tract infections, and skin conditions.⁷

Botanical classification of Bhumi Amla:

KINGDOM	PLANTAE
DIVISION	Magnoliophyte
CLASS	Magnoliopsida
ORDER	Euphorbiales
FAMILY	Euphorbiaceae
GENUS	Phyllanthus
SPECIES	Niruri

Phytochemical Composition

The medicinal plant known as Bhumi Amla (Phyllanthus Niruri) is well-known for its diverse phytochemical makeup and potential for treatment. Alkaloids, flavonoids, lignans, tannins, polyphenols, terpenoids, and saponins are among the many different types of bioactive substances that are present in it.⁸ The plant's strong antioxidant qualities are attributed to its abundance of phenolic chemicals, which include gallic acid and ellagic acid. Important lignans with hepatoprotective properties include phyllanthin and hypophyllanthin. Bhumi Amla also includes a number of minerals, including calcium and potassium, as well as important vitamins, like vitamin C. Its anti-inflammatory, antibacterial, antiviral, and hepatoprotective properties are all attributed to these phytochemicals, which makes it an important tool in both conventional and alternative medicine.⁹

Table 1 -

Phytochemicals	Compound	Application
Alkaloids	Phyllanthine, Nirurine , Phyllanthin	to have antimicrobial and hepatoprotective properties

Glycosides	Niruriside , Phyllanthoside	composed of a sugar molecule and a molecule that isn't. They have anti-inflammatory, antioxidant, and anticancer qualities, among other health advantages.
Flavonoids	Quercetin , Kaempferol , Gallic acid	have antioxidant and anti-inflammatory properties. They may also help to protect against heart disease and cancer.
Tannins	Phyllanthusiin , Corilagin	contributing to wound healing and gut health.
Terpenoids	Phyllanthol , Niruradol	consist of essential oils and triterpenes with antibacterial, anti-inflammatory, and anti-cancer qualities.
Phenolic acids	Caffeic acid , Ferulic acid	enhance general health by aiding in the plant's anti-inflammatory and antioxidant properties.

Compounds including phyllanthin, hypophyllanthin, and quercetin have been discovered as important contributors to antimicrobial action by analytical methods like GC-MS and HPLC.

Antimicrobial activity

Bhumi Amla (*Phyllanthus Niruri*) has a well-established antibacterial effect that is ascribed to its diverse phytochemical makeup.⁴ Both Gram-positive and Gram-negative bacterial infections are among the several bacterial pathogens against which the plant demonstrates strong antibacterial activity. By breaking down bacterial cell walls, preventing enzyme function, and obstructing microbial DNA replication, bioactive substances like alkaloids, flavonoids, tannins, phenolics, and

saponins add to its antibacterial effectiveness.¹⁰ Extracts from Bhumi amla have been shown in studies to be very efficient against common bacterial strains, including *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Escherichia coli*. According to these results, Bhumi Amla may be used as a natural supplement or substitute for synthetic antibiotics, particularly in light of the growing prevalence of antibiotic resistance. It has strong antibacterial qualities that make it a good option for wound healing and infection treatment.¹¹

Its antibacterial effectiveness is attributed to bioactive substances such as alkaloids, flavonoids, tannins, phenolics, and saponins, which break down bacterial cell walls, prevent enzyme activity, and obstruct microbial DNA replication. Research has shown that Bhumi Amla preparations are very efficacious against common types of bacteria, including *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Escherichia coli*. Given the growing prevalence of antibiotic resistance, our results imply that Bhumi Amla may be used as a natural supplement or substitute for manufactured antibiotics. It is a potential option for the treatment of infections and the promotion of wound healing due to its strong antibacterial qualities.¹²

Antifungal activity

Bhumi Amla (*Phyllanthus Niruri*) has a wide range of bioactive substances, including tannins, alkaloids, flavonoids, and saponins, which are responsible for its strong antifungal properties. Together, these substances prevent the development and spread of many fungal infections. Ergosterol production, which is essential for preserving the integrity of fungal cell membranes, is mostly interfered with in the antifungal mechanism, which disrupts fungal cell walls and membranes.¹³ Furthermore, by causing the generation of reactive oxygen species (ROS), the plant's flavonoids and phenolic chemicals cause oxidative stress in fungal cells, which results in cell damage and death. Bhumi Amla preparations have been shown to be effective against common fungal pathogens like as *Trichophyton rubrum*, *Aspergillus niger*, and *Candida albicans*. Its antifungal potential indicates that

it can be used to treat fungal infections and that it can serve as a natural substitute for synthetic antifungal medications, especially when dealing with drug-resistant fungal strains.¹⁴

Interference with the synthesis of ergosterol, which is necessary for the integrity of fungal cell membranes.

Antiviral activity

Bhumi Amla prevents the virus from entering host cells by disrupting the viral surface proteins' ability to attach to host receptors,. Furthermore, it inhibits enzymes necessary for the manufacture of viral genomes, including as DNA polymerase and reverse transcriptase, which slows viral replication. Further supporting the removal of viral infections are the immunomodulatory qualities of the plant, which strengthen the human immune response. Research has indicated that it is effective against many viruses, including the human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV). Inhibiting viral protein synthesis and lowering HBV DNA levels highlight Bhumi Amla's potential as a natural antiviral drug, providing a viable substitute for treating viral infections.¹⁵

Methods of Extraction and Testing

A. Extraction Methods

Using a Soxhlet system, Bhumi Amla is extracted by putting the solvent in a round-bottom flask and the powdered plant material in a thimble. In order to extract phytochemicals, the solvent continuously circulates through the plant material, vaporising, condensing, and dripping back into the apparatus.¹⁶ The extracted phytochemicals are obtained by collecting the extracted solution and evaporating the solvent. This technique provides better yield, less solvent consumption, and effective extraction.¹⁷

B. Antimicrobial Testing

The Disc Diffusion Method is commonly used for testing byprepare microbial cultures on agar plates. On the agar, place filter paper discs that have been impregnated with Bhumi Amla extract. Measure the zone of inhibition after

incubation.¹⁸

MIC stands for minimum inhibitory concentration. Make Bhumi Amla extract serial dilutions. To every dilution, add microbial cultures. After incubating, find the MIC.¹⁹

Conclusion

The study shows that Bhumi Amla, also known as *Phyllanthus Niruri*, has been shown to have strong antibacterial and antifungal effects against a variety of microorganisms and other microbes. Gram-positive and gram-negative bacteria, such as *E. Coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*, as well as a variety of fungal strains, including *Candida albicans* and *Aspergillus niger*, have all been discovered to be susceptible to the plant's effects. Because bioactive compounds like phyllanthin, nirurin, and corilagin have been shown to inhibit the growth of microorganisms by inhibiting cell wall synthesis, disrupting cell membrane integrity, and interfering with DNA replication and transcription, Bhumi Amla is said to have antimicrobial activity. Due to this, Bhumi Amla may be used as a natural preservative in food and cosmetic products to prolong their shelf life and prevent spoiling, as well as a potential natural remedy for a variety of infections, such as respiratory, urinary, and skin and wound infections. Overall, study on Bhumi Amla's antimicrobial activity is important, and more investigation is required to completely grasp its potential as a natural antibacterial agent.

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