

Phyllanthus niruri L.: A Comprehensive Review of Its Ethnopharmacology, Phytochemistry, and Pharmacological Potential

Mr Deepak Kumar Maurya¹, Mr. Madhav Kumar², Dr. O.P. Verma³

¹Research Scholar, ²Assistant Professor, ³Director & Professor, Department of Pharmacy,
Goel Institute of Pharmacy and Sciences

Corresponding Author: Mr Deepak Kumar Maurya¹

Abstract

Phyllanthus niruri L., a widely distributed pantropical medicinal herb belonging to the family Phyllanthaceae, has been extensively utilized in traditional systems of medicine for the management of hepatic, renal, and metabolic disorders. Commonly known as “Chanca Piedra” or “Bhumyamalaki,” the plant holds significant ethnopharmacological importance due to its diverse therapeutic applications, particularly in the treatment of liver diseases and urolithiasis. This review consolidates current knowledge on the morphology, geographical distribution, phytochemical composition, and pharmacological activities of *P. niruri*. Phytochemical investigations reveal the presence of a complex matrix of bioactive constituents, including lignans (phyllanthin, hypophyllanthin), flavonoids (quercetin, rutin), tannins (ellagic acid, corilagin), alkaloids, and terpenes, which collectively contribute to its multi-target therapeutic profile. Pharmacological studies, both in vitro and in vivo, have demonstrated significant hepatoprotective, anti-urolithiatic, antiviral, anticancer, anti-inflammatory, and antioxidant activities. The hepatoprotective effects are primarily mediated through antioxidant defense enhancement and stabilization of hepatocellular membranes, while anti-urolithiatic activity involves inhibition of calcium oxalate crystallization and facilitation of stone expulsion. Additionally, the plant exhibits promising antiviral activity against hepatitis B virus and cytotoxic effects against various cancer cell lines. Despite extensive research, challenges such as taxonomic confusion and lack of standardization persist. Overall, *P. niruri* represents a potent natural therapeutic agent with significant potential for integration into modern pharmacotherapy, warranting further clinical validation and standardization studies.

Keywords: Phyllanthus niruri; Bhumyamalaki; Chanca Piedra; hepatoprotective; anti-urolithiatic; phytochemistry; lignans; phyllanthin; antiviral activity; natural products; ethnopharmacology; antioxidant activity

1. Introduction

Phyllanthus niruri L. is a prominent, highly valued, and extensively researched medicinal plant that has served as a cornerstone in various traditional and alternative systems of medicine across the globe. Taxonomically, it belongs to the family Phyllanthaceae, though it was historically and broadly classified under the large and diverse Euphorbiaceae family before phylogenetic restructuring separated the two (Mao et al., 2016). A small, short-lived annual herbaceous plant, *P. niruri* is globally recognized for its profound therapeutic potential.



Figure 1: *Phyllanthus niruri* L growing in the wild

The plant's identity is deeply intertwined with its ethnobotanical history; it is most famously known in Spanish-speaking regions of South America as "Chanca Piedra," a phrase that translates directly to "stone breaker." This moniker accurately reflects its widespread and historical use by indigenous populations of the Amazon basin to treat and expel painful kidney stones and gallstones (Calixto et al., 1998). Beyond South America, the plant holds an equally revered status in Eastern medical traditions. In the ancient Indian Ayurvedic system of medicine, *P. niruri* is highly esteemed as "Bhumyamalaki" or "Bhumi Amla." Within this framework, it is classified as a premier hepatoprotective agent, traditionally administered in the form of decoctions, infusions, and powders to treat severe hepatic disorders including jaundice, liver cirrhosis, hepatitis, and spleen enlargement (Patel et al., 2011). In other regions of the world, it is known by diverse vernacular names such as "dukong anak" in Malaysia, "sampa-sampalukan" in the Philippines, and "quebra-pedra" in Brazil, underscoring its pantropical distribution and universal ethnopharmacological utility. The genus *Phyllanthus* is massive, encompassing over a thousand distinct species, many of which share overlapping morphological characteristics and phytoconstituents. However, *Phyllanthus niruri* stands out in the scientific literature due to its exceptionally potent and specific bioactive profile. Historically, indigenous healers utilized the entire plant—incorporating the aerial parts (leaves, stems, and flowers) as well as the roots—to manage a plethora of ailments. These extended beyond hepatic and renal diseases to encompass gastrointestinal discomfort, diarrhea, dyspepsia, diabetes, respiratory diseases, genitourinary infections, and even malaria (Bagalkotkar et al., 2006). In recent decades, there has been a paradigm shift in how *P. niruri* is viewed, transitioning it from a purely folkloric remedy to a subject of rigorous, evidence-based scientific scrutiny. This shift has been driven by the global pharmaceutical demand for safe, natural, and economically viable therapeutic alternatives, particularly in light of the limitations and adverse effects associated with synthetic drugs used for chronic liver and renal management (Kaur et al., 2017). Extensive *in vitro* and *in vivo* pharmacological studies have sought to validate the traditional claims surrounding *P. niruri*, leading to the discovery of a complex, synergistic matrix of secondary metabolites. Despite the extensive scientific validation of its efficacy, significant challenges remain regarding taxonomic confusion. There is frequent misidentification in commercial herbal markets between *P. niruri* and closely related species like *Phyllanthus amarus* and *Phyllanthus urinaria* (Khatoon et al., 2006). Consequently, a thorough understanding of its precise morphological markers, alongside its chemistry and pharmacology, is imperative for

the standardization, quality control, and integration of this botanical into modern clinical practice.

2. Morphology

Accurate botanical identification and macroscopic evaluation of *Phyllanthus niruri* are highly critical due to its striking physical similarity to other members of the *Phyllanthus* genus. Misidentification can lead to variations in the phytochemical profile of harvested materials, which subsequently impacts therapeutic efficacy. *P. niruri* is characterized as a delicate, erect, and glabrous (entirely hairless) annual herb that typically reaches a vertical height of 30 to 60 centimeters, heavily dependent on environmental variables such as soil fertility, moisture availability, and sunlight exposure (Calixto et al., 1998). Its life cycle is relatively short, allowing it to rapidly colonize and proliferate as a weed during favorable climatic periods, particularly during the onset of seasonal monsoon rains.

Habit, Stem, and Branching: The plant exhibits a bushy, highly branched habit. The main central stem is distinctly herbaceous, slender, smooth, and cylindrical, possessing a characteristic light green hue. It branches profusely from the base upwards. A defining morphological characteristic of the *Phyllanthus* genus, and prominently displayed in *P. niruri*, is its specialized lateral branchlets. These branchlets exhibit plagiotropic growth—meaning they grow horizontally or at an oblique angle away from the main vertical stem—and are distinctly flattened. Because of the specific arrangement of the leaves along these branchlets, each individual branchlet visually mimics a single pinnately compound leaf (Khatoon et al., 2006).

Leaves: The leaves of *P. niruri* are simple, numerous, and relatively diminutive. They are arranged alternately along the slender lateral branchlets in two distinct, opposite rows—a botanical formation known as a distichous arrangement. The leaves are closely spaced, often slightly overlapping one another (imbricating), which further contributes to the optical illusion that the entire branchlet is a single, large compound leaf. Morphologically, the leaf blades are elliptic to elliptic-oblong in shape, featuring an obtuse or slightly rounded apex and a distinctly asymmetrical base. They are sessile, meaning they possess an exceptionally short petiole that tightly attaches them to the branchlet. Tiny, highly acute, and lanceolate stipules (small leaf-like appendages) are present at the base of each petiole (Mao et al., 2016).

Flowers: *Phyllanthus niruri* is a monoecious species, indicating that it bears distinct, separate male and female flowers on the exact same individual plant. The inflorescences are incredibly small, visually inconspicuous, and apetalous (lacking true petals). They emerge directly from the axils of the leaves (the angle between the leaf and the stem).

- **Male (Staminate) Flowers:** The male flowers are predominantly clustered toward the proximal end (closer to the main stem) of the lateral branchlets. They typically appear in tiny, distinct clusters or cymules of one to three flowers. They are yellowish-white, occasionally exhibiting a slight reddish or purplish tinge near their base. The perianth usually consists of five to six tiny sepals, and they contain three distinct stamens with anthers that are apically acute (Bagalkotkar et al., 2006).
- **Female (Pistillate) Flowers:** The female flowers are typically solitary and are found further down the distal end (towards the tip) of the branchlets. They are slightly larger than their male counterparts and possess a superior ovary, which eventually develops into the fruit.

Fruits, Seeds, and Roots: The fruit development of *P. niruri* is highly characteristic and provides its most widespread common English name: "seed-under-leaf." The fruit is a tiny, oblate (flattened sphere) capsule, roughly 2 to 3 millimeters in diameter. These capsules hang directly beneath the branchlets, tightly sequestered and hidden under the overlapping leaves. The capsules are stramineous (straw-colored), distinctly reticulate (featuring a faint net-like pattern), and smooth. Upon reaching full maturation, the capsules dehisce (split open explosively) to release tiny, wedge-shaped seeds. These seeds exhibit longitudinal ridges or a rugose texturing along their surface, a microscopic detail often used by taxonomists to differentiate *P. niruri* from the smooth-seeded *P. amarus* (Khatoon et al., 2006). The root system is relatively simple, consisting of a slender, pale, and fibrous taproot with secondary lateral branching, designed to anchor the plant effectively in loose or sandy soils.

3. Geographical Sources

Phyllanthus niruri demonstrates a remarkable ecological plasticity, allowing it to establish itself across a vast and diverse geographical expanse. While its evolutionary and taxonomic origins are strongly traced back to the tropical regions of the Americas—specifically the Amazon rainforest and the coastal areas spanning from Texas southward through Mexico,

Central America, and Brazil—its highly adaptive nature has facilitated its naturalization across almost all tropical and subtropical zones globally (Mao et al., 2016).

Global Pantropical Distribution: Today, the geographic footprint of *P. niruri* is distinctly pantropical. Beyond its native South American range, where it remains a staple in traditional Amazonian medicine, it is extensively distributed across Asia, Africa, and Oceania. In the Asian continent, it is highly prevalent in China, Malaysia, Indonesia, the Philippines, and Sri Lanka. In Africa, it is frequently documented in West African nations, including Nigeria and Ghana, where local populations utilize it similarly for its antimalarial and hepatoprotective properties (Bagalkotkar et al., 2006). The plant's seeds are highly resilient and easily dispersed by water and wind, classifying *P. niruri* technically as a widespread, persistent weed in many global agricultural and wild ecosystems.

Distribution and Ecology in India: Within the Indian subcontinent, *Phyllanthus niruri* is practically ubiquitous, though it exhibits a strong ecological preference for coastal environments, central plains, and regions experiencing heavy monsoonal precipitation. It is abundantly found in the wild across the states of Jharkhand, Bihar, Chhattisgarh, Andhra Pradesh, Karnataka, Tamil Nadu, and Odisha (Khatoun et al., 2006).

The plant's life cycle in India is intimately tied to the seasonal monsoon. It typically emerges as a wild, opportunistic weed in late June with the onset of the first significant monsoon showers. *P. niruri* exhibits rapid vegetative growth through the highly humid months of July and August, bearing fruit toward the middle of the rainy season. Provided the environmental conditions remain sufficiently moist and the plant is protected from extreme winter frost, it can survive well into the cooler months of November and December.

(Image source: Wikimedia Commons - P. niruri growing as an opportunistic weed in a naturalized, moist environment)

Habitat and Soil Preferences: Ecologically, *P. niruri* thrives optimally in moist, highly humid environments with well-drained, slightly acidic to neutral soils. It is commonly found growing in disturbed soils, including wastelands, fallow agricultural fields, home gardens, roadsides, and the sandy banks of riverbeds. It frequently occupies the understory of larger, dominant vegetation, favoring shaded or semi-shaded microclimates that protect its delicate, thin leaf structures from excessive desiccation by direct, intense tropical sunlight (Calixto et

al., 1998). Furthermore, in specific geographical niches, the plant has demonstrated a profound resilience to harsh, nutrient-poor substrates, including heavily weathered lateritic soils, further cementing its status as an exceptionally hardy botanical species.

4. Phytochemistry

The immense therapeutic value and multifaceted pharmacological profile of *Phyllanthus niruri* are inextricably linked to its diverse, complex, and highly concentrated phytochemical matrix. Extensive qualitative and quantitative biochemical analyses over the past four decades have successfully isolated over 120 distinct bioactive constituents from the plant's aerial parts, roots, and seeds (Patel et al., 2011). These secondary metabolites represent a highly evolved biochemical defense system for the plant which, when extracted and introduced to human biology, interact simultaneously with multiple physiological pathways. The principal classes of phytoconstituents include lignans, flavonoids, tannins, alkaloids, and terpenes.

Lignans (The Hepatoprotective Core): Lignans, a diverse group of polyphenolic compounds, constitute the most pharmacologically significant and heavily researched fraction of *P. niruri*, particularly concerning its renowned effects on liver health. The two most prominent and abundant lignans identified within the plant are **phyllanthin** and **hypophyllanthin** (Kaur et al., 2017).

(Image source: Wikimedia Commons - The molecular structure of Phyllanthin, the principal bioactive lignan in P. niruri)

These highly lipophilic compounds are extracted primarily from the hexane and chloroform fractions of the aerial parts (leaves and stems). Phyllanthin and hypophyllanthin are highly potent anti-hepatotoxic agents; they function at the cellular level by stabilizing the hepatocellular membrane and preventing the leakage of vital transaminase enzymes during chemically induced oxidative stress. Beyond these two primary markers, the plant yields a rich spectrum of other bioactive lignans, including niranthin, nirtetralin, phyltetralin, lintetralin, and isolintetralin (Bagalkotkar et al., 2006). These specific molecules have demonstrated a remarkable capacity to interfere with viral transcription and aggressively inhibit lipid peroxidation within the liver parenchyma.

Flavonoids (The Antioxidant Matrix): Flavonoids form the robust, systemic antioxidant foundation of the plant. *Phyllanthus niruri* is exceptionally rich in several specific flavonols and their glycosides, most notably **quercetin**, **rutin** (quercetin-3-O-rutinoside), **astragalín**, and **kaempferol rhamnoside** (Mao et al., 2016).

- **Quercetin:** A ubiquitous but highly powerful free-radical scavenger found in high concentrations within the leaves. It protects cellular DNA from oxidative damage and exhibits significant anti-inflammatory and chemopreventive properties by modulating cell cycle pathways.
- **Rutin:** This flavonoid is instrumental in supporting vascular health by strengthening capillary walls, improving microcirculation, and synergistically amplifying the plant's overall antioxidant capacity alongside vitamin C (which is also present in trace amounts).

Tannins and Phenolic Acids: Tannins are astringent, polyphenolic biomolecules that bind to and precipitate proteins. In *P. niruri*, the hydrolyzable tannins and related phenolic acids are highly abundant and critically important for its urological benefits. The major isolates include **ellagic acid**, **corilagin** (and its isomer isocorilagin), **gallic acid**, and **geraniin** (Calixto et al., 1998).

- **Ellagic Acid & Corilagin:** These compounds are extensively studied for their profound nephroprotective properties. Ellagic acid, in particular, plays a direct, mechanistic role in preventing the endocytosis of calcium oxalate crystals in renal tubular cells, thereby mitigating kidney injury and stone formation. Corilagin contributes significantly to the plant's in vitro antiviral activity and hepatoprotective efficacy.
- **Gallic Acid:** A simple phenolic acid that helps normalize elevated levels of liver enzymes following acute hepatic injury and provides a strong baseline of antimicrobial activity against opportunistic pathogens.

Alkaloids: Alkaloids are basic, naturally occurring organic nitrogen-containing compounds. While present in smaller total yields compared to lignans and tannins, the alkaloid fraction of *P. niruri* is highly specialized. The primary alkaloids identified include **nirurine**, **securinine**, **norsecurinine**, and **phyllanthimide** (Patel et al., 2011). Nirurine is primarily responsible for the plant's remarkable antispasmodic activity. By inducing the relaxation of

smooth muscles within the urinary tract, ureters, and biliary tree, this alkaloid facilitates the painless expulsion of renal calculi and gallstones, providing the pharmacological basis for the "Chanca Piedra" moniker.

Terpenes and Saponins: The volatile oil fraction of the plant contains various mono- and sesquiterpenes, such as **limonene**, **p-cymene**, and **alpha-pinene**. These volatile aromatic compounds contribute to the plant's distinct odor, as well as its topical anti-inflammatory, antibacterial, and mild bronchodilatory effects. Additionally, protodemetallic saponins present in *P. niruri* modulate the immune system, increase the permeability of cellular membranes to allow other active constituents to enter, and provide an additional layer of antiviral and antibacterial defense (Kaur et al., 2017).

5. Pharmacological Activities

The translation of *Phyllanthus niruri*'s complex phytochemical matrix into measurable clinical and pharmacological outcomes has been the subject of intense global research. The myriad of bioactive compounds—particularly the lignans, hydrolyzable tannins, and flavonoids—interact synergistically with multiple physiological pathways. This multi-target mechanism of action provides a broad spectrum of therapeutic effects, validating its extensive traditional use and positioning it as a highly valuable botanical in modern pharmacotherapy.

Hepatoprotective Activity: The protection, detoxification, and regeneration of hepatic tissue is the most heavily validated pharmacological action of *P. niruri*. The liver is exceptionally vulnerable to oxidative stress and chemical toxins due to its primary role in xenobiotic metabolism. Experimental *in vivo* models utilizing potent hepatotoxins, such as carbon tetrachloride (CCl₄), thioacetamide, galactosamine, and acetaminophen (paracetamol), have consistently demonstrated the profound protective efficacy of *P. niruri* extracts (Bhattacharjee & Sil, 2006).

The mechanism of toxicity for agents like CCl₄ involves its metabolic conversion by cytochrome P450 enzymes into highly reactive trichloromethyl radicals, which rapidly initiate the lipid peroxidation of the hepatocellular membrane, leading to cell death (necrosis). The lignans in *P. niruri*—specifically phyllanthin and hypophyllanthin—act as powerful chain-breaking antioxidants. They intercept these free radicals before they can

degrade the lipid bilayer. Furthermore, the extracts actively restore and significantly enhance the intrahepatic levels of critical endogenous antioxidant defense enzymes, primarily Superoxide Dismutase (SOD), Catalase (CAT), and reduced Glutathione (GSH) (Kaur et al., 2017). Clinical and experimental observations reveal that administration of *P. niruri* rapidly normalizes elevated serum markers of liver distress (AST, ALT, ALP, and total bilirubin) while simultaneously stimulating hepatic cellular regeneration, making it highly effective in the management of acute and chronic hepatitis, jaundice, and chemically induced cirrhosis.

Anti-Urolithiatic (Kidney Stone) Activity: Urolithiasis, characterized primarily by the formation of calcium oxalate (CaOx) and uric acid stones in the kidneys or urinary tract, is a prevalent, highly recurrent, and painful disease. *Phyllanthus niruri* intervenes in the pathogenesis of stone formation at multiple, critical stages, definitively validating its "Chanca Piedra" (stone breaker) moniker.

Interestingly, *in vitro* and *in vivo* studies indicate that the aqueous extracts do not necessarily lower urinary calcium levels or completely prevent the initial precipitation of calcium oxalate. Instead, the phytoconstituents—heavily driven by the hydrolyzable tannin **ellagic acid**—profoundly alter the morphology of the crystals. The plant extract interferes with the crystallization process (nucleation, growth, and aggregation), rendering the resulting crystals significantly smaller, smoother, and less prone to clumping together into a larger calculus (Barros et al., 2003). At the cellular level, the extract aggressively inhibits the endocytosis (cellular internalization) of these calcium oxalate crystals by renal tubular epithelial cells. By preventing the crystals from anchoring to the kidney tissue, the plant prevents the cellular damage that typically forms the "nidus" (core) for large stone growth. Furthermore, the plant's alkaloid fraction exhibits potent antispasmodic properties, relaxing the smooth musculature of the ureters, which facilitates the rapid and relatively painless expulsion of small stones and gravel (Nishiura et al., 2004).

Antiviral Activity: *P. niruri* possesses highly specialized and targeted antiviral properties, most notably against the Hepatitis B Virus (HBV)—a major global cause of chronic liver disease and hepatocellular carcinoma. Research initiated in the late 1980s using the Woodchuck Hepatitis Virus (WHV) model, which is closely related to human HBV, demonstrated that the plant's aqueous extracts effectively inhibit the endogenous DNA polymerase enzyme of the virus (Venkateswaran et al., 1987).

By disabling DNA polymerase, the plant effectively halts the transcription and replication of the viral genome. Additionally, specific phenolic components within the extract have been shown to bind directly to the surface antigens of the virus (HBsAg). This binding impedes the virus's ability to attach to and enter healthy host hepatocytes. This dual action—halting replication and preventing cellular entry—makes *P. niruri* a potent natural adjunct in the management of chronic viral hepatitis, often aiding in the seroconversion and clearance of the virus in human subjects (Bagalkotkar et al., 2006).

Anticancer and Anti-Proliferative Activity: The strategy of chemoprevention using botanical agents is a rapidly expanding field of oncology, and *P. niruri* has exhibited selective toxicity against a diverse array of cancer cell lines. Hydroalcoholic extracts and specific isolated fractions have demonstrated remarkable anti-proliferative effects against human lung carcinoma (A549), breast carcinoma (MCF-7), human colorectal carcinoma (HT29), and hepatocellular carcinoma (HepG2) (Mao et al., 2016).

The mechanism of action relies heavily on the polyphenolic matrix (quercetin, rutin, gallic acid, and ellagic acid), which acts as a cytoprotective agent for normal, healthy cells while exhibiting cytotoxic effects on neoplastic cells. The extracts modulate the cell cycle, frequently inducing arrest at the G2/M phase. Furthermore, they trigger apoptosis (programmed cell death) in cancer cells via the activation of intrinsic caspase pathways and the induction of DNA fragmentation.

Anti-Inflammatory, Analgesic, and Systemic Antioxidant Activities: Systemic, unchecked inflammation is a primary driver of almost all chronic diseases. Extracts of *P. niruri* exhibit potent, peripherally mediated anti-inflammatory and antinociceptive (pain-relieving) properties. In standard experimental models (such as carrageenan-induced paw edema), the extract successfully inhibited inflammation by downregulating the synthesis of pro-inflammatory mediators, primarily prostaglandins and leukotrienes, via the inhibition of cyclooxygenase (COX) and lipoxygenase (LOX) enzymes (Calixto et al., 1998).

These anti-inflammatory effects are fundamentally linked to the plant's massive antioxidant capacity. The continuous neutralization of reactive oxygen species (ROS) by the plant's flavonoids and tannins prevents the oxidative stress that triggers cellular inflammatory cascades. This makes *Phyllanthus niruri* not only a targeted therapeutic for the liver and

kidneys but also a highly effective systemic botanical for managing oxidative damage and chronic pain.

Conclusion

Phyllanthus niruri represents a remarkable intersection of traditional ethnobotanical wisdom and modern pharmacological science. Its complex phytochemical profile—anchored by hepatoprotective lignans, anti-urolithiatic tannins, and antioxidant flavonoids—validates its centuries of use in managing severe metabolic, viral, and urological diseases. As the global medical community continues to seek out safe, multi-target therapeutic agents, *P. niruri* stands out as a highly viable candidate for integration into evidence-based clinical practice, particularly in the realms of hepatology and urology.

References

- Bagalkotkar, G., Sagineedu, S. R., Saad, M. S., & Stanlas, J. (2006). Phytochemicals from *Phyllanthus niruri* Linn. and their pharmacological properties: a review. *Journal of Pharmacy and Pharmacology*, 58(12), 1559-1570.
- Calixto, J. B., Santos, A. R. S., Cechinel Filho, V., & Yunes, R. A. (1998). A review of the plants of the genus *Phyllanthus*: their chemistry, pharmacology, and therapeutic potential. *Medicinal Research Reviews*, 18(4), 225-258.
- Kaur, N., Kaur, B., Sirhindi, G., & Bhatti, R. (2017). Phytochemistry, pharmacology, and pharmacotherapeutics of *Phyllanthus niruri* L. (Bhumyamalaki): A review. *Journal of Pharmacognosy and Phytochemistry*, 6(4), 1645-1652.
- Khatoon, S., Rai, V., Rawat, A. K. S., & Mehrotra, S. (2006). Comparative pharmacognostic studies of three *Phyllanthus* species. *Journal of Ethnopharmacology*, 104(1-2), 79-86.
- Mao, X., Wu, L. F., Guo, H. L., Chen, W. J., Cui, Y. P., Qi, Q., ... & Chen, Y. X. (2016). The genus *Phyllanthus*: An ethnopharmacological, phytochemical, and pharmacological review. *Evidence-Based Complementary and Alternative Medicine*, 2016, 1-36.
- Patel, J. R., Tripathi, P., Sharma, V., Chauhan, N. S., & Dixit, V. K. (2011). *Phyllanthus amarus*: Ethnomedicinal uses, phytochemistry and pharmacology: A review. *Journal of Ethnopharmacology*, 138(2), 286-313.

- Bagalkotkar, G., Sagineedu, S. R., Saad, M. S., & Stanslas, J. (2006). Phytochemicals from *Phyllanthus niruri* Linn. and their pharmacological properties: a review. *Journal of Pharmacy and Pharmacology*, 58(12), 1559-1570.
- Calixto, J. B., Santos, A. R. S., Cechinel Filho, V., & Yunes, R. A. (1998). A review of the plants of the genus *Phyllanthus*: their chemistry, pharmacology, and therapeutic potential. *Medicinal Research Reviews*, 18(4), 225-258.
- Kaur, N., Kaur, B., Sirhindi, G., & Bhatti, R. (2017). Phytochemistry, pharmacology, and pharmacotherapeutics of *Phyllanthus niruri* L. (Bhumyamalaki): A review. *Journal of Pharmacognosy and Phytochemistry*, 6(4), 1645-1652.
- Khatoun, S., Rai, V., Rawat, A. K. S., & Mehrotra, S. (2006). Comparative pharmacognostic studies of three *Phyllanthus* species. *Journal of Ethnopharmacology*, 104(1-2), 79-86.
- Mao, X., Wu, L. F., Guo, H. L., Chen, W. J., Cui, Y. P., Qi, Q., ... & Chen, Y. X. (2016). The genus *Phyllanthus*: An ethnopharmacological, phytochemical, and pharmacological review. *Evidence-Based Complementary and Alternative Medicine*, 2016, 1-36.
- Patel, J. R., Tripathi, P., Sharma, V., Chauhan, N. S., & Dixit, V. K. (2011). *Phyllanthus amarus*: Ethnomedicinal uses, phytochemistry and pharmacology: A review. *Journal of Ethnopharmacology*, 138(2), 286-313.
- Bagalkotkar, G., Sagineedu, S. R., Saad, M. S., & Stanslas, J. (2006). Phytochemicals from *Phyllanthus niruri* Linn. and their pharmacological properties: a review. *Journal of Pharmacy and Pharmacology*, 58(12), 1559-1570.
- Barros, M. E., Schor, N., & Boim, M. A. (2003). Effects of an aqueous extract from *Phyllanthus niruri* on calcium oxalate crystallization in vitro. *Urological Research*, 30(6), 374-379.
- Bhattacharjee, R., & Sil, P. C. (2006). The protein fraction of *Phyllanthus niruri* plays a protective role against acetaminophen induced hepatic disorder via its antioxidant properties. *Phytotherapy Research*, 20(7), 595-601.
- Calixto, J. B., Santos, A. R. S., Cechinel Filho, V., & Yunes, R. A. (1998). A review of the plants of the genus *Phyllanthus*: their chemistry, pharmacology, and therapeutic potential. *Medicinal Research Reviews*, 18(4), 225-258.
- Kaur, N., Kaur, B., Sirhindi, G., & Bhatti, R. (2017). Phytochemistry, pharmacology, and pharmacotherapeutics of *Phyllanthus niruri* L. (Bhumyamalaki): A review. *Journal of Pharmacognosy and Phytochemistry*, 6(4), 1645-1652.

- Mao, X., Wu, L. F., Guo, H. L., Chen, W. J., Cui, Y. P., Qi, Q., ... & Chen, Y. X. (2016). The genus *Phyllanthus*: An ethnopharmacological, phytochemical, and pharmacological review. *Evidence-Based Complementary and Alternative Medicine*, 2016, 1-36.
- Nishiura, J. L., Campos, A. H., Boim, M. A., Heilberg, I. P., & Schor, N. (2004). *Phyllanthus niruri* normalizes elevated urinary calcium levels in calcium stone forming (CSF) patients. *Urological Research*, 32(5), 362-366.
- Venkateswaran, P. S., Millman, I., & Blumberg, B. S. (1987). Effects of an extract from *Phyllanthus niruri* on hepatitis B and woodchuck hepatitis viruses: in vitro and in vivo studies. *Proceedings of the National Academy of Sciences*, 84(1), 274-278.