Phyllanthus Niruri (Bhumyamlaki): An Integrative Review Of Its Pharmacognostic Insights And Multidimensional Therapeutics Potential

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Background:

Phyllanthus niruri, a small herb of the Euphorbiaceae family, is traditionally referred to as the "stone breaker" and is widely utilized in ethnomedicine.

Objective:

This review aims to summarize the pharmacological potential of *P. niruri* with special focus on its hepatoprotective, antiviral, and nephroprotective activities.

Methodology:

Relevant literature from traditional medicinal texts, experimental studies, and modern pharmacological reports was critically reviewed to assess the therapeutic applications of *P. niruri*.

Results:

P. niruri exhibits potent hepatoprotective effects, commonly employed to reduce hepatic toxicity and improve liver function. It shows antiviral activity by suppressing Hepatitis B virus replication. The herb is also recognized for its nephroprotective role, promoting kidney function and facilitating the dissolution and elimination of renal stones. Other notable pharmacological actions include antidiabetic, antiulcer, antimicrobial, and anti-inflammatory properties.

Conclusion:

P. niruri is a promising medicinal herb with broad therapeutic potential, especially in liver and kidney disorders. However, further clinical studies are warranted to establish its safety, efficacy, and role in modern therapeutics.

Keywords:

Phyllanthus niruri, Euphorbiaceae, Stone Breaker, hepatoprotective, antiviral, nephroprotective, Therapeutic potential, traditional medicine.

1. INTRODUCTION

With nearly 600 species, the genus Phyllanthus includes: tree and shrub, and some few plants in the family: Euphorbiaceae. One of these species, P. niruri, was research look for the pharmacological, and phytochemical activity. [1] For almost over all 2,000 years, species of P.niruri has been used for Ayurvedic treatment, and Ayurveda medicine used for variety of condition like as: a including diabetes, gonorrhea, jaundice, and irregular menstruation. Jamu, a well-known herbal remedy from Indonesia that treats many diseases, contains it as a main ingredient. The hepatoprotective and antiviral qualities of the plant are used in jamu medicines. Known as Dukong anak in Malaysia, P. niruri is used to broad spectrum of disase: treat to condition such as: gonorrhea, coughs, diarrhea, and kidney issues. [2] P.accuminatus, P.niruri, P.watsonii, P.amarus, P.pulcher, P.niruroides, P.orbiculatus, P.simplex, P.emblica, P.oxyphyllus, P.flexuosus, P.fraternes, P.mullernus, P.urinaria, P.anisolobus, P.mytrifolis, P.virgatus, are among the more than 600 species that have been studied for their pharmacological activity, and phytochemical characteristics. The genus is widespread throughout the world's warmer regions. [3] The amazon rainforest, and other tropical regions such as: India, Southern, China, and South East Asia, are the home to the small, upright annual herb known as P.niruri, height of 30 to 40 cm. [4] It has sessile, oblong, alternating leaves that length range from 6 to 12 cm. Its tiny, auxiliary, pedicellate, apetalous, monoecious, off-white-greenish flowers are solitary. Drier part of this plant found in veriety of country: India, Florida, Brazil, and Texas. Two species of P. amarus and P. sellowianus are properties, activity, and chemical composition are same as well as P. niruri. The two troublesome and perplexing species, P. niruri and P. amarus, are two distinct species, according to a recent paper that used cladistic analysis to show that the Phyllanthus genus is paraphyletic. [5]. His medicinal potential has recently been uncovered by more scientific investigation, primarily in relation to liver disorders, diabetes, and hepatitis B. [6, 7]


Fig. (1). Herb Plant of Phyllanthus Niruri

2. HISTORICAL AND ETHNOMEDICINAL USE

For decades, several traditional medical systems have praised Phyllanthus niruri, also known as Stonebreaker, Chanca Piedra, or "Bhumi Amla" in Ayurveda, for its extraordinary healing qualities, especially in the treatment of kidney stones and urinary diseases. The Amazonian rainforests to the old Indian and Chinese healing customs, its ethnomedicinal heritage crosses continents, demonstrating its broad acceptance as a powerful herbal cure. [8, 9]

2.1. Traditional Use in Ayurveda and Siddha Medicine:

Rasayana (rejuvenative herb), P. niruri (Bhumi Amla) is used in Ayurveda to balance the Pitta and Kapha doshas. Ancient writings like the Sushruta Samhita and Charaka Samhita its use for:

a) **Mutra Ashmari (Kidney and Bladder Stones):** To treat dysuria and dissolve calculi, the herb was given as a powder or decoction.
b) **Yakrit Vikara (Liver Disorders):** It was recommended to treat hepatitis, liver detoxification, and jaundice.
c) **Prameha (Urinary Disorders):** Used to treat urinary problems caused by diabetes.
d) **Jvara (Fever) and Shotha (Inflammation):** utilized as an anti-inflammatory and anti-pyretic substance. Similarly, P. niruri (Keelanelli) was employed as a diuretic, liver cleanser, and jaundice remedy in Siddha medicine, another ancient Indian school.

2.2. Amazonian and Latin American Folk Medicine: Indigenous groups in the Amazon region, including the Shipibo-Conibo and Ashaninka, have long utilized P. niruri (Chanca Piedra) as a main treatment for:

a) **Kidney and Gallbladder Stones**: Its capacity to break up and expel calculi is directly referenced in the herb's Spanish name, Chanca Piedra ("Stone Breaker").
b) **Urinary Tract Infections (UTIs):** used as a tea or antibacterial wash to cure illnesses.
c) **Digestive Ailments:** Intestinal parasites, ulcers, and gastritis are treated with tablets.

2.3. Traditional Chinese Medicine (TCM) and Southeast Asian Practices: According to TCM, P. niruri, also known as Ye Xia Zhu, is a cooling plant that is used to:

a) **Clear Damp-Heat:** taking care of ailments like inflammation of the urinary tract and jaundice.
b) **Detoxify the Liver:** For hepatitis, it is used with other herbs, such as bleurum.
c) **Promote Diuresis:** used in urine obstruction and edema formulations

2.4. Malaysia and Indonesia: It have long utilized the Dukung Anak plant as a liver tonic and fever remedy. In West Africa, especially Nigeria, P. niruri is utilized in African and Caribbean ethnomedicine as an antipyretic for fever and malaria. As an organic diuretic for hypertension. Apply topically as a poultice to promote wound healing. It is used similarly in the Caribbean to treat kidney stones, urinary tract infections, and as a general detoxifier. [10] This word "Bhumyamalaki" refers to a number of veriety of P. amarus Schum and Thonn, P. fraternus Web, P. maderaspatensis Linn., P. simplex Retz., and P. urinaria Linn. are among the Phyllanthus species. [11, 12] Particularly against the hepatitis B virus, the Phyllanthus niruri plant exhibits pharmacological action. [13, 14]

3. COMMON NAMES

Table No. 1 Regional Names of *Phyllanthus niruri* (Bhui Amla) Across Indian Languages

Language	Names
Sanskrit	Bhumyamalaki, Bhudhatri, Tamlaki, Bahupatra, Bahuphala, Amala, Sukshmadala, Vitunika, Bhoodatri
Hindi	Chalmeri, Harfarauri, Bhui amla, Bhuiaonla
Kannada	Kirunelli, Nela Nelli
Marathi	Bhuiawala, Rayavali, Bhuiavli
Gujarati	Bhonya Awala
Assamese	Holpholi, Poram: Lokhi

Bengali	Noar
Konkani	Bhuin-avalae
Telugu	Ratsavusirike, Nela Usiri
Tamil	Arunelli, Keela Nelli
Malayalam	Arinelli, Kizhanelli, Nellipuli
Oriya	Narakoli

4. BOTANICAL CLASSIFICATION OF PLANT

Table No. 2 Taxonomic Classification of *Phyllanthus niruri* (Bhui Amla)

Rank	Name
Kingdom	Plantae
Class	Dicotyledoneae
Order	Malpighiales
Family	Phyllanthaceae
Genus	Phyllanthus
Species	niruri
Botanical Name	*Phyllanthus niruri*

5. SCIENTIFIC CLASSIFICATION

Table No. 3 Comprehensive Taxonomic Hierarchy of *Phyllanthus niruri* Linn (Gulf Leaf Flower)

Rank	Name
Domain	Eukaryota
Kingdom	Plantae
Clade	Angiosperms, Eudicots, Rosids
Order	Malpighiales
Family	Phyllanthaceae
Genus	*Phyllanthus*
Species	*P. niruri*

Latin Name	*Phyllanthus niruri* Linn
English Name	Gulf leaf flower

6. PHARMACOGNOSTICAL STUDIES

6.1 Habit and Habitat: Its oval oblong leaves are 3.0-11.0 x 1.5-6.0 mm. The leaves are oval and oblong and range in height from 10 to 60 cm. [16] The upright, treaded stem has leaves that are 3.0-11.0 x 1.5-6.0 mm. The younger sections are tough. The first 2-3 axils of axillary flowers are unisexual with 1-3 male flowers, followed by bisexual blooms in the subsequent axils. A 1 mm long pedicel, a 5-oblong, elliptic calyx with a hyaline and acute apex, and an unbranched midrib are characteristics of the male flowers. Five rounded segments of the disc have three stamens and three connate filaments, while five rounded segments have three connate filaments and three stamens.

6.2 Description [17]

6.2.1 Macroscopic

a) **Root**: 2.5–11.0 cm in length, small. Light brown, fractured, short, nearly straight, tapering gradually, and having several fibrous secondary and tertiary roots.
b) **Stem:** Thin, glabrous, light brown and cylindrical which are 20–75 cm long, with a profusion of branches pointing upward and five to ten pairs of leaves on the internode, 1-3.5 cm long and has a slightly bitter taste and indistinct odor.
c) **Leaf:** These compounds and leaflets are grouped in two rows with a rachis, alternate, opposing, and decussate virtually sessile, stipulate, oblong, and whole, up to 1.5 cm long and 0.5 cm wide with greenish-brown in color, vague odor and a slightly bitter taste.

6.2.2 Microscopic

a) **Root:** In the transverse section, four to six layers of cork can be seen, consisting of thin-walled, rectangular cells that are tangentially elongated and arranged in a radial pattern. The secondary cortex contains 8–10 layers of thin-walled, reddish-brown parenchymatous cells. The secondary phloem is narrow, made of sieve elements and phloem parenchyma, and crossed by thin phloem rays. The secondary xylem forms a wide zone with vessels, tracheids, fibers, and parenchyma, all of which are thick-walled, lignified, and have simple pits.
b) **Stem:** In transverse section, the stem shows a single-layered epidermis composed of thick-walled, flattened, tangentially elongated cells. In older stems, four to five layers of cork are present, consisting of thin-walled, tabular, tangentially elongated, and radially arranged cells containing

reddish-brown material. The cortex consists of four to six layers of oval, thin-walled, tangentially elongated parenchymatous cells, with some cells containing yellowish-brown deposits. The endodermis is well defined, followed by a discontinuous pericycle formed by tangentially elongated, lignified fibers with thick walls and narrow lumina. The secondary phloem is narrow and composed of sieve elements interspersed within phloem parenchyma. The secondary xylem consists of vessels, fibers, and parenchyma, predominantly with simple pitted vessels. Occasionally, cluster crystals of calcium oxalate are observed in the parenchymatous cells of the ground tissue. Some cells show spiral thickenings. The fibers are long, narrow, with tapering or occasionally blunt ends, and contain simple pits. At the center, the pith is composed of thin-walled, round to oval parenchymatous cells.

c) **Leaf:** The transverse section of the leaf shows a biconvex outline with a single-layered epidermis on both surfaces, externally covered by a thick cuticle. The mesophyll is dorsiventral, consisting of a single palisade layer beneath the upper epidermis and three to five layers of loosely arranged spongy parenchyma traversed by veins. The epidermal cells are thin-walled, tangentially elongated, and bear anisocytic stomata on both surfaces. The vascular bundle (meristele) is distinct, with xylem directed towards the upper side and phloem towards the lower side. Cluster crystals of calcium oxalate are occasionally present in the parenchymatous and spongy tissues. Phyllanthus amarus has both anisocytic and paracytic stomata, but microscopic analysis of the P. fraternus and P. maderaspatensis that are the Phyllanthus species only have anisocytic stomata. The epidermal cell wall of P. fraternus and P. amarus are wavy, while those of P. maderaspatensis are smooth.

6.2.3 Powder: Under a microscope, the brown medicinal powder displays pieces of cork cells, vessels, and fibers.

7. PHYTOCHEMISTRY

Numerous active components, including glycosides, flavonoids, alkaloids, ellagitannins, phenyl propanoid, amarin, germanin, and corilagin, are present in the plant's leaves, stem, and roots. [18] Numerous chemical components have been reported to be present in P. amarus, including lignans, phyllanthin, hypophyllanthin, nortiphyllin, and phylline; flavanone glycosides, including niranthin, nirtetralin, phyltetralin, and lintetralin; triterpenes, including phyllanthus, phyllanthenone, and phyllanthenol; and flavonoids, including quercetin, quercitrin, and astragalin.

7.1 Alkaloid: The medicinal herb Phyllanthus niruri, also referred to as "Bhumi Amla," is abundant in bioactive substances, with alkaloids playing a key part in its pharmacological effects. The plant has been shown to contain important alkaloids such as nor-securinine, isobubbialine, norricinine, phyllanthine, and hypophyllanthine. These substances provide a number of medicinal benefits, such as antiviral, anti-inflammatory, antioxidant, and hepatoprotective properties. It is well known that

the lignan alkaloids phyllanthine and hypophyllanthine can shield liver tissues from oxidative damage. [19] Chromatographic techniques like HPLC and TLC are commonly used to identify these alkaloids after they have been extracted using methanol or ethanol. They are clinically significant because they can promote liver function and prevent the hepatitis B virus from replicating. [20]

7.2 Flavonoids:

7.2.1 Rutin: Quercetin, a flavonol, combines with the disaccharide rutinose to form a flavonol glycoside. This compound belongs to the large group of phenolic secondary metabolites in plants, which includes more than 2000 identified compounds. [21] Rutin is important as it strengthens capillaries and provides therapeutic benefits in conditions like arteriosclerosis and hypertension. [22] Free radicals are believed to contribute to nearly 90% of human diseases, including cancer, arteriosclerosis, stroke, and age-related degenerative conditions. Recent studies indicate that rutin acts as a strong antioxidant capable of neutralizing these free radicals. [23]

7.2.2 Quercetin: It plays a vital nutritional role by strengthening blood vessel walls and modifying their permeability, especially in capillaries. [24] This bioactive compound exhibits properties such as inhibiting aggregation, combating cancer, fighting fungal infections (especially dermatophytes), deterring feeding, reducing intraocular pressure, alleviating inflammation, scavenging free radicals, preventing infection, and relieving spasms. [25]

7.2.3 Astragalin: Astragalin is a diuretic and flavanone. Through boosting phagocytosis, boosting macrophage counts, and encouraging antibody formation, it can also control both human and animal immune systems. [26] Astragalin suppresses passive cutaneous anaphylaxis (PCA) reactions in mice and reduces histamine release in the human basophil cell line KU812. It may also decrease serum IgE concentrations and reduce both the incidence and severity of dermatitis in NC/NGA atopic mice. [27] Histological analysis of mouse skin treated with D-N-galactosamine-lipopolysaccharide showed reduced infiltration of inflammatory cells. [28]

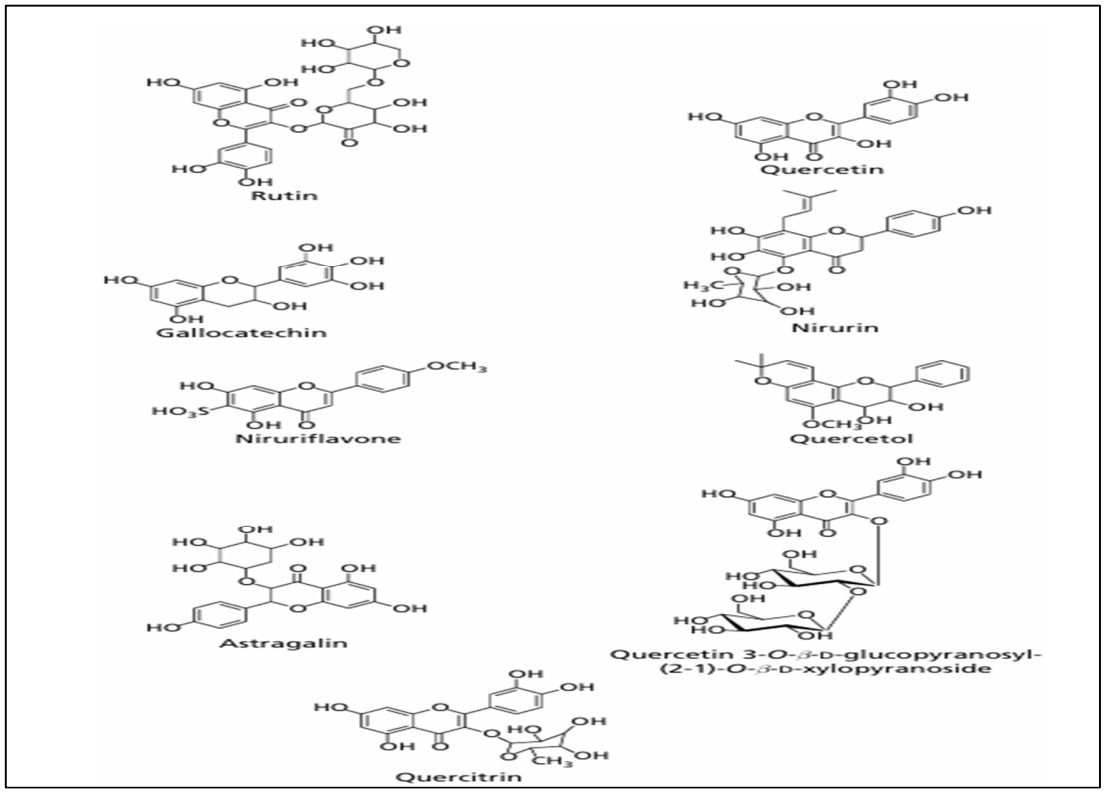

Fig. (2). Structure of chemical constituents of flavonoids.

7.3 Terpenes:

7.3.1 Limonene: It is a monoterpenoid with numerous pharmacological and medicinal uses. [29] The Diels-Alder reaction, two molecules of isoprene can be converted into two limonene molecules, which are mirror images of one another. [30] Orange oil contains a significant amount of the limonene. It has documented that limonene has anti-carcinogenic properties in liver tumor models. [31] Studies have shown that limonene enhances the penetration of diclofenac in hairless rats, suggesting its potential as a useful topical agent for both superficial and deep wounds. [32] According to Allardyce et al. (2003), p-Cymene (Figure 3) is a member of the monoterpene group and exhibits the wide ranges of biological activities, including anti-oxidant and anti-microbial activity [33] Thyme essential oil, rich in p-cymene, showed strong antioxidant activity by preventing the oxidation of α-tocopherol. [34]

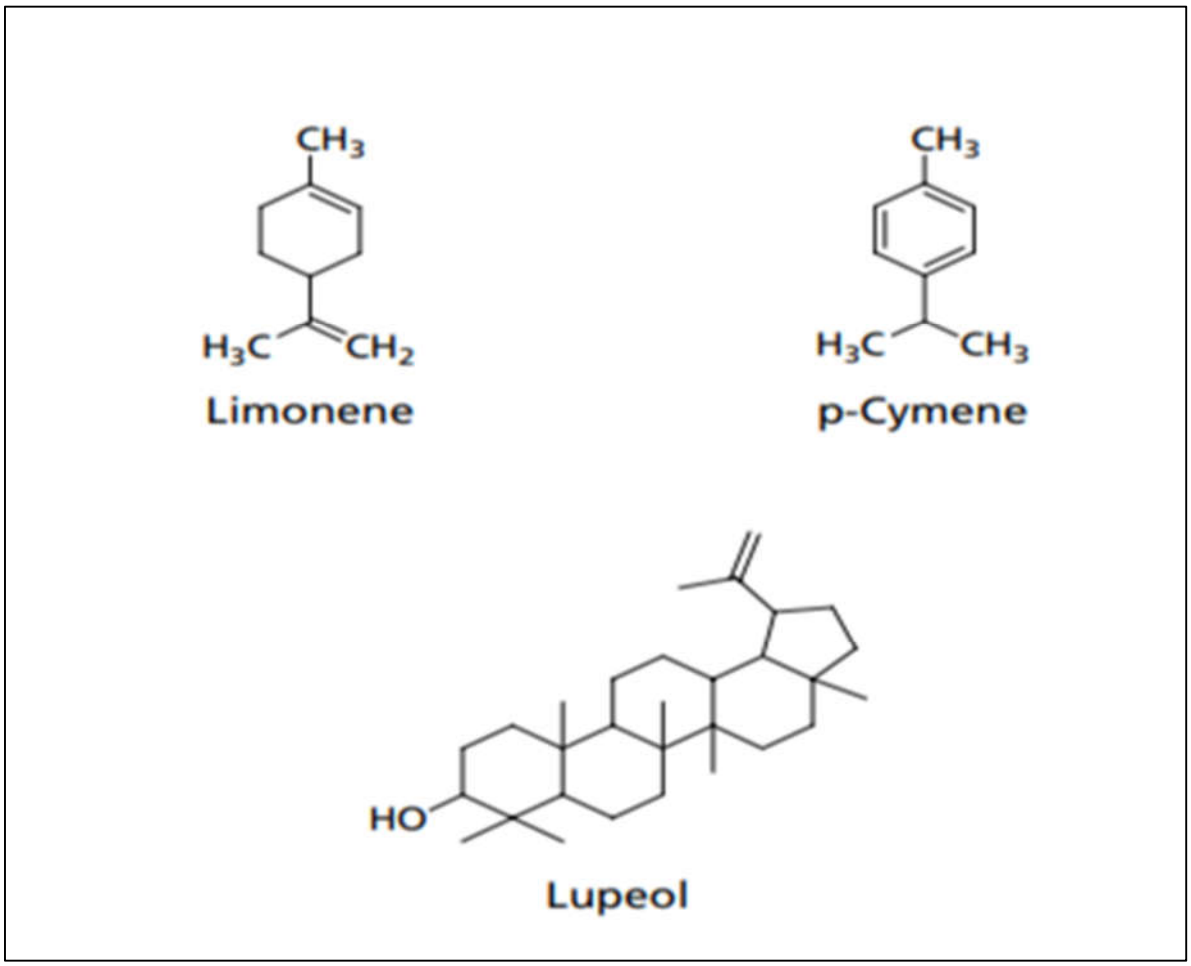

Fig. (3). Structure of chemical constituents of Terpenoids

7.3.2 Lupeol: Lupeol is a pentacyclic triterpene formed through backbone rearrangement involving a protosterol carbocation. [35] It inhibits the production of superoxide by stopping human neutrophils from tyrosyl phosphorylating a 45 kDa protein. [36] The substance has demonstrated antitumor and anti-inflammatory properties. [37, 38] More intriguingly, it has been demonstrated that lupeol and its derivatives prevent CaOx crystal aggregation in the experimental urolithiasis. [39] Simulating the whole-plant extract's activities.[40] One potent skin chemopreventive that can be reduce benzoyl peroxide-induced cutaneous toxicity is luteol.[41] Moreover, it can strengthen the liver's antioxidant capacity to protect rats from cadmium-induced damage.[42]

7.4 Coumarins:

Acid ellagic Ellagic acid is a phenolic molecule with strong antiviral and anticarcinogenic effects (Figure 4). Ellagic acid is not usually present in plants in its free form. Instead, it is derived from ellagitannins, a class of compounds formed when polymers of gallic acid and hexahydroxy di-phenoyl (HHDP) groups bind to glucose units. [43] In tannin molecules, the HHDP group is formed

by the side-by-side linkage of two gallic acid units. Upon cleavage and spontaneous rearrangement of the HHDP group, ellagic acid is produced. Among dietary sources, red raspberries are the only food proven to supply ellagic acid to the body. [44, 45] In cultured human cells exposed to carcinogens, ellagic acid from red raspberries was discovered to the lower the incidence of cancer and stop carcinogens from attaching to DNA. This ability to scavenge cancer-causing compounds and render them inert was linked to ellagic acid's cancer chemopreventive activity. It also prevented other compounds from causing bacterial mutations. Some papers that quantify ellagitannins utilize ellagic acid as a reference because ellagitannins are quantified by disassembling them into the ellagic acid subunit and then measuring the subunit. [46]

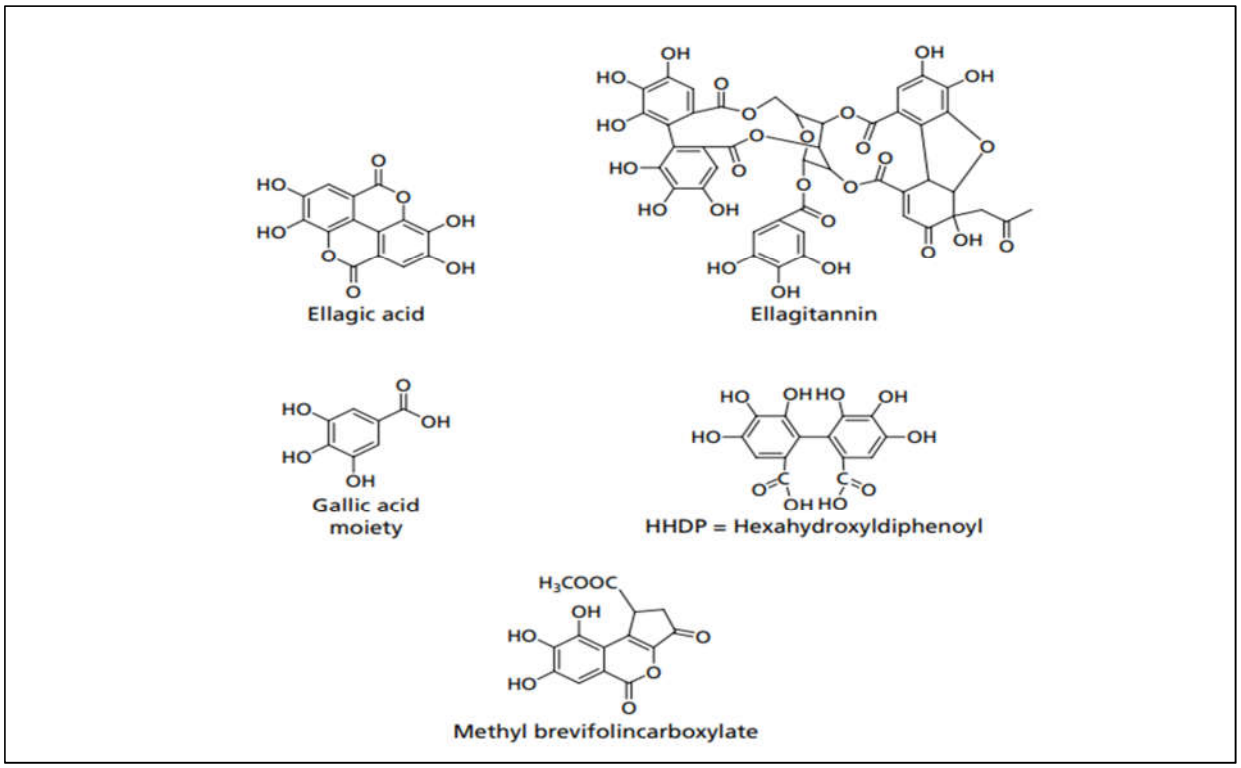

Fig. (4). Chemical structures of ellagic acid, gallic acid, ellagitannin, the hexahydroxydiphenoyl (HHDP) moiety, and methyl brevifolincarboxylate.

7.5 Lignans:

The lignan compounds, phyllanthin and hypophyllanthin (Figure 5), have been reported to exhibit hepatoprotective and anti-genotoxic activities. [47] The liver transferase enzyme level and protein level were dramatically elevated by galactosamine and CCl4, although the two substances showed a strong defense against these effects. Additionally, it has been observed that these substances inactivate hepatitis B in the *in vivo* and *in vitro* setting. [48, 49]. Phyllanthin, an

aryltetrahydronaphthalene-type lignan identified by Sagar et al. (2004), has demonstrated inhibitory activity against reverse transcriptase, indicating its potential as an antiviral agent against HIV. In addition to phyllanthin, Phyllanthus niruri also contains the lignans niranthin, nirtetralin, phyltetralin, and lintetralin (see Figure 5). Notably, phyltetralin, nirtetralin, and niranthin have exhibited anti-inflammatory effects by suppressing neutrophil infiltration and reducing carrageenan-induced paw edema. [50, 51] Niranthin and nirtetralin were identified to possess anti-HBsAg and anti-HBeAg activities, effectively inhibiting the expression of HBsAg and HBeAg at a non-cytotoxic concentration of 50 mM. Additionally, several other compounds, including linnanthin, demethylenedioxyniranthin, nirphyllin, phyllnirurin, isolintetralin, 2,3-desmethoxy seco-isolintetralin, and its diacetate derivative, were isolated from *P. niruri* (Figure 5). [52-54] Two hydroxy-lignans, namely seco-isolariciresinol trimethyl ether and hydroxyniranthin, along with a known dibenzylbutyrolactone and a rare secolignan, seco-4-hydroxylintetralin, were isolated. In addition, 3,4-methylenedioxybenzyl-3′,4′-dimethoxybenzylbutyrolactone was obtained from the leaves of *P. niruri*. This compound, previously isolated from *Bursera schlechtendalii*, has been reported to exhibit anti-tumor activity. [55]

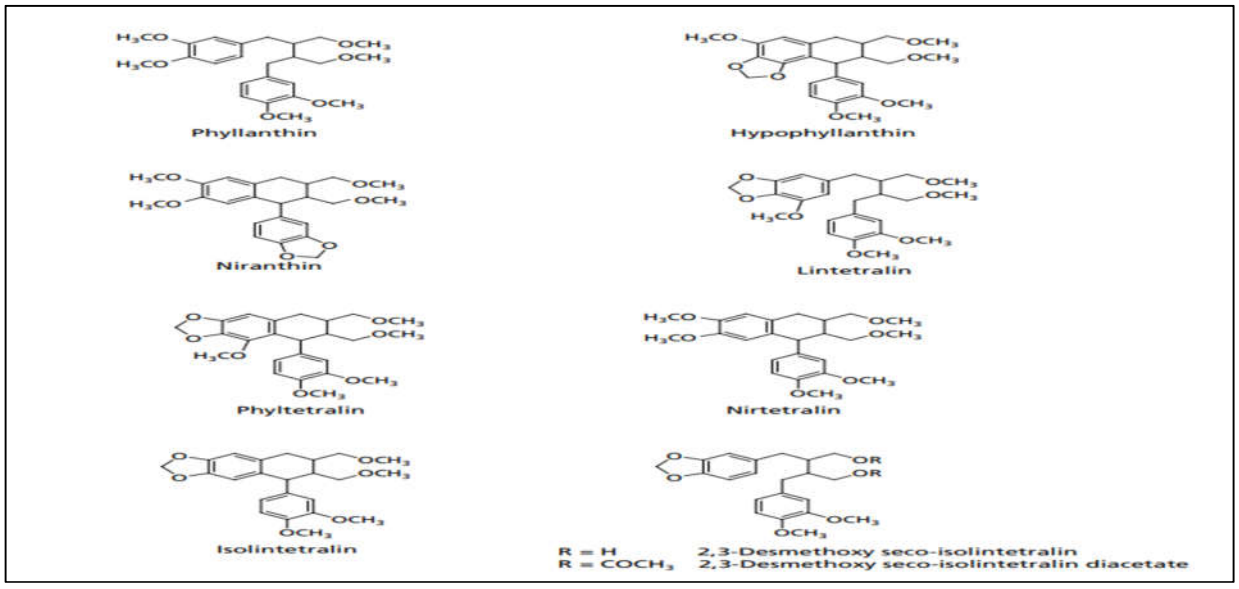

Fig. (5). Chemical structures of Lignans

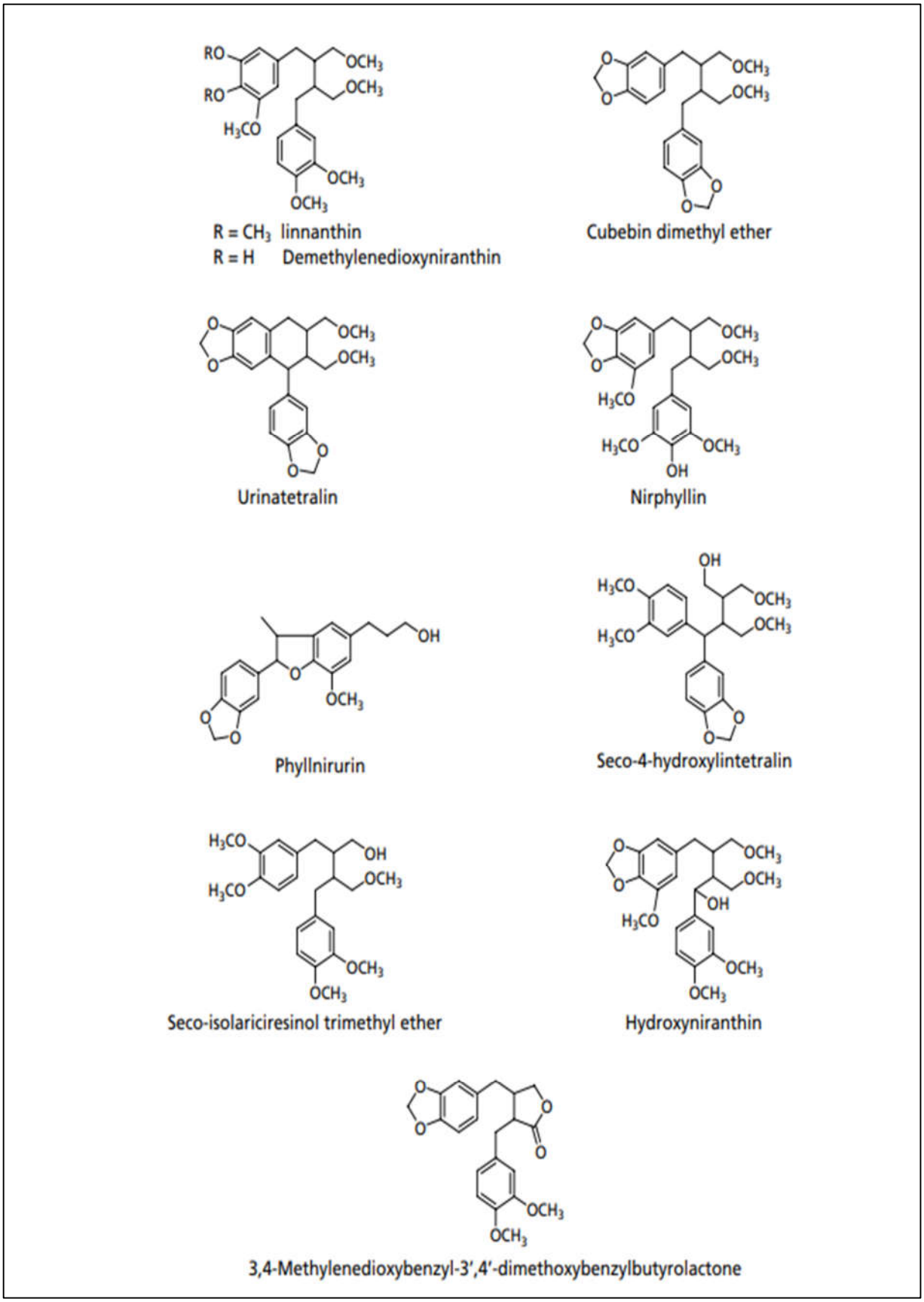

Fig. (6). Continued

Table 4. Phytoconstituents reported in Phyllantyhus Niruri

S.No.	CLASS	COMPOUND	Reference
1.	Alkaloid	Ent-norsecurinine 4-methoxy-nor-securinine Nirurine	[58, 59]
2.	Sterol	Isopropyl-24-cholesterol Estradiol B-sitosterol	[58, 59]
3.	Lignan	Niranthin Phyltetralin Hinokinin Lintetralin Hypophyllanthin Nirphyllin Phyllnirurin Phyllanthin Isolintetralin 2,3-desmethoxy seco-isolintetralin Demethylenedioxyniranthin	[58, 59]
4.	Triterpene	Phyllantheol Lupeol acetate Phyllanthenol Limonene Lupeol p-Cymene Phyllanthenone	[58, 59]
5.	Lipid	Ricinoleic acid	[58, 59]
6.	Phytallate	Phyllester	[58, 59]
7.	Saponins	Diosgenin	[58, 59]
8.	Benzenoid	Benzenoid	[58, 59]
9.	Coumarins	Methyl brevifolin carboxylate Ethyl brevifolin carboxylate Ellagic acid	[58, 59]

8. PHARMACOLOGICAL ACTIVITY: A study conducted on humans revealed that P. niruri had a substantial diuretic impact in addition to hypotensive and hypoglycemic effects. A study conducted on humans revealed that P. niruri had a substantial diuretic impact in addition to hypotensive and hypoglycemic effects. [58] Known as Pitirishi or Budhatri in India, is also popular home medicine for bronchitis, jaundice, tuberculosis, anemia, asthma and caugh. [59] In Brazilian herbal medicine, *Phyllanthus niruri*, commonly known as Quebra Pedra, has been traditionally valued for its therapeutic benefits in managing bladder infections, dropsy, and various urinary tract disorders. It is also employed in the treatment of diabetes, hepatitis, and kidney-related ailments. [60-62] The alkaloid extract of *Phyllanthus niruri* has been shown to exhibit smooth muscle relaxant activity in both the urinary and biliary systems. [63] Studies on *Phyllanthus niruri* have demonstrated its antiviral activity against HIV, where a simple aqueous extract of the plant was found to inhibit HIV-1 reverse transcriptase. [64, 65] A Brazilian study team found that consuming P. niruri lowers calcium levels in urine by analyzing a subset of the patients who had hypercalciuria.

8.1 Antiviral activity: Phyllanthus niruri's antiviral action, specifically against the hepatitis B virus (HBV), is its most well studied impact. The duplication of HBV is thus inhibited by phyllanthin and hypophyllanthin, which block the viral DNA polymerase. Recent studies have consistently demonstrated that dietary supplements can lower patients' HBV virus loads. [66] And offer sufficient proof that this medication has been used traditionally to treat viral hepatitis. [67] Additionally, Phyllanthus niruri has been proven in multiple studies to have anti-hepatitis B infection properties as well as some effects against other viruses including HIV and herpes simplex. [68, 69]

8.2 Hepatoprotective activity: Because of its hepatoprotective properties, Phyllanthus niruri has been extensively studied. Animal research and clinical trials demonstrate that Phyllanthus niruri shields liver cells from poisons like alcohol and carbon tetrachloride, effectively restoring lost liver function and reducing inflammation. [70] Moreover, new studies have confirmed earlier assertions that Phyllanthus niruri may help lower liver inflammation and enzyme levels in those with cirrhosis and hepatitis. [71-72]

8.3 Anticancer activity: Epidemiological and experimental evidence indicates that medicinal plants hold considerable therapeutic potential in the prevention and management of various cancers, including lung, breast, colon, liver, prostate, skin, and ovarian cancers. Hence, phytochemicals—purified molecules derived from medicinal plants—have the ability to significantly suppress the proliferation of many kinds of cancer cells. [73]

8.4 Kidney Health: The herb phyllanthus niruri, which is historically referred to as the "stone breaker," has been used to cure and eradicate kidney stones. This occurs "due to prevention of calcium oxalate crystal formation and also by dissolving established crystals," according to research. The therapeutic use of *Phyllanthus niruri* extract in managing renal calculi has gained substantial support, as clinical trials have demonstrated a significant reduction in kidney stone size among treated patients.

8.5 Anti-inflammatory activity and Antioxidant activity: Due to the many kinds of flavonoids and phenolic chemicals, which can lower oxidative stress and free radicals, Phyllanthus niruri has a notably high level of antioxidant activity. Phyllanthus niruri's anti-inflammatory properties been demonstrated to be effective in reducing inflammation in people suffering from chronic inflammatory illnesses. [74, 75]

8.6 Anti-diabetic Activity: The ethanolic extract of *Phyllanthus niruri* was found to significantly reduce blood glucose levels in experimental rats with insulin-dependent diabetes mellitus, while showing no effect in normoglycemic rats. [76] Furthermore, the ethanolic extract was shown to markedly improve lipid profile parameters in both insulin-dependent and non-insulin-dependent diabetic animal models, evidenced by reductions in plasma cholesterol, triglycerides, low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), and atherogenic index, alongside an elevation in high-density lipoprotein (HDL) cholesterol. In contrast, a short-term clinical study in non-insulin-dependent diabetic patients reported that an aqueous extract of *Phyllanthus amarus* aerial parts failed to significantly reduce fasting or postprandial blood glucose levels in untreated subjects. [77] The aqueous extract of *Phyllanthus niruri* demonstrated pronounced hypoglycemic activity in streptozotocin-induced diabetic rats, while the methanolic extract similarly produced a significant reduction in blood glucose levels in alloxan-induced diabetic models. [78, 79]

8.7 Anti-hyperlipidemic Activity: Research has demonstrated the antihyperlipidemic properties of Phyllanthus niruri, also known as Bhoomyamlaki. Additionally, it was stated that aqueous extract had antihyperlipidemic properties. P.amarus leaf hydro-alcoholic extract was also shown to have antihyperlipidemic effects in hyperlipidemic mice. [80, 81] Furthermore, mice fed a High Fat Diet (HFD) were given phyllanthin, evaluation of bioactive compound of P.niruri, over a 12-weeks period. This prevented the mice from gaining weight and becoming obese, reduced the mRNA levels of adipogenic genes while enhancing the expression of lipolytic genes in white adipose tissue. Decreased the deposition of liver triglycerides, restored the selenium lipid disturbances caused by the HFD, and decreased the triglycerides serum and free fatty acids in mice fed of the HFD. [82] The lipid-lowering effects of Phyllanthus niruri were found to be mediated through the activation of tissue lipases and lecithin–cholesterol acyltransferase (LCAT), enhanced fecal bile acid

excretion, increased low-density lipoprotein (LDL) catabolism, and inhibition of hepatic cholesterol synthesis. [83]

9. Drug Interactions: Significant of Pharmacokinetic drug Interactions. [84, 85]

Drug Class	**Interaction/Effect**
Antidiabetic drugs	May intensify hypoglycemia effects → requires blood glucose monitoring
Antihypertensives	Potential additive reduction in blood pressure when combined with antihypertensives
Diuretics	Could worsen electrolyte imbalance
Immunosuppressants	Potential issues due to their immunomodulatory effects

10. Contraindications:

- A traditional use as an emmenagogue during pregnancy
- Plants of the Phyllanthaceae family are known to cause hypersensitivity.
- Oliguria and anuria associated with acute renal failure.

Relative Contraindications Requiring Monitoring

- Theoretical antiplatelet impact in patients taking anticoagulants
- Immunostimulation-related autoimmune diseases.
- Electrolyte abnormalities (caused by the diuretic action).

CONCLUSION:

Phyllanthus niruri, commonly known as “Bhumi Amla,” has gained significant scientific interest due to its diverse pharmacological properties. Traditionally employed in Ayurveda and various other medicinal systems, this plant has been utilized for the management of liver ailments, renal calculi, diabetes, and infectious diseases. Its therapeutic potential is largely attributed to bioactive constituents, including alkaloids, lignans, and flavonoids, which impart antiviral, anti-inflammatory, and antioxidant properties. In preclinical and clinical trials, it has demonstrated encouraging outcomes as a natural therapy. Despite promising results, more clinical trials and standardizat ion of extracts are necessary to ensure efficacy and safety in human applications. Overall, Phyllanthus niruri holds strong promise as a natural source of medicine, and further research may lead to the development of effective herbal formulations for modern healthcare. Its

incorporation into pharmacological treatments could offer cost-effective, its safety, efficacy, and dosage in herbal therapeutic practices globally.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: study conception and design: A.P. & A.T; data collection and writing the paper M.F. All authors reviewed the results and approved the final version of the manuscript.

LIST OF ABBREVIATIONS

TCM: Traditional Chinese Medicine

MM: Millimeter

CM: Centimeter

HPLC: High Performance Liquid Chromatography

TLC: Thin Layer Chromatography

IgE: Immunoglobulin E

KDa: Kilo Daltons

HHDP: Hexa Hydroxy di Phenyl

DNA: Deoxyribo Nucliec Acid

HIV: Human Immunodeficiency virus

HBV: Hepatitis B Virus

HFD: High Fat Diet

mRNA: messenger Ribonucleic Acid

LCAT: Lecithin-Cholesterol Acyl Transferase

LDL: Low-Density Lipoprotein

CONSENT FOR PUBLICATION

Not Applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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