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## An Overview: Pharmacognostic Properties of *Phyllanthus amarus* Linn.

B. Joseph and S.J. Raj

Interdisciplinary Research Centre, Department of Biotechnology,  
Malankara Catholic College, Mariagiri, K.K. District, India

**Abstract:** *Phyllanthus amarus* (Euphorbiaceae) is a widely distributed small erect, tropical annual herb whose stem has green capsule and grows upto 10-60 cm tall. The plant is bitter, astringent, cooling, diuretic, stomachic, febrifuge and antiseptic. It is popular in indigenous system of medicine like ayurveda, siddha, unani and homoeopathy and is used for its hepatoprotective, antitumour, antidiabetic, antihypertensive, analgesic, anti-inflammatory and antimicrobial properties. The plant is also used in dropsy, jaundice, diarrhoea, dysentery, intermittent fevers, diseases of urino-genital system, scabies, ulcers, wounds and cold. It has a good anti-viral activity against hepatitis B virus. It also has anti-nociceptive and anti-inflammatory activities, antidiabetic and antilipidemic potentials. The present review is therefore, an effort to give a detailed survey of the literature on its pharmacological, traditional and phytochemical properties.

**Key words:** Pharmacological, antioxidant, antiviral, antiseptic, antidiuretic, amarulone, *Phyllanthus amarus*

### INTRODUCTION

The *Phyllanthus* genus of the family Euphorbiaceae was first identified in Central and Southern India in 18th century. It is commonly called carry me seed, stone-breaker, windbreaker, gulf leaf flower or gala of wind (Bharatiya, 1992). There are over 300 genera with over 5000 species in the Euphorbiaceae worldwide. The *Phyllanthus* is one of the genus that falls under this enormous family. *Phyllanthus* has about 750-800 species, found in tropical and subtropical regions worldwide. Green medicine is safe and more dependable than the costly synthetic drugs, many of which have adverse side effects (Joseph and Raj, 2010a). The use of medicinal plants by man for the treatment of diseases has been in practice for a very long time. Screening of compounds obtained from plants for their pharmacological activity has resulted in the isolation of innumerable therapeutic agents. *P. amarus* is an erect annual herb of not more than one and half feet tall and has small leaves and yellow flowers. In folk medicine *P. amarus* has reportedly been used to treat jaundice, diabetes, otitis, diarrhoea, swelling, skin ulcer, gastrointestinal disturbances and blocks DNA polymerase in the case of hepatitis B virus during reproduction (Oluwafemi and Debiri, 2008). The beneficial medicinal effects of plant materials typically result from the combinations of secondary products present in the plant (Joseph and Raj, 2010b). Several compounds including alkaloids, flavonoids, lignans, phenols and terpenes were isolated from this plant and some of them interact with most key

enzymes. In traditional medicine, it is used for its hepatoprotective, anti-diabetic, antihypertensive, analgesic, anti-inflammatory and antimicrobial properties (Adeneye *et al.*, 2006a, b). *Phyllanthus amarus* leaf extract as a hepatoprotective agent. The plant is also used in the treatment of stomach disorders, skin diseases and cold (Kokwaro, 1976; Iwu, 1993). It has anti-diarrhea effect (Odetola and Akojenu, 2000). Its anti-viral activity against hepatitis B virus has been established (Thyagarajan *et al.*, 1988; Wang *et al.*, 1995) anti-carcinogenic (Joy and Kuttan, 1998) and antimutagenic activities (Joy and Kuttan, 1998). It also has anti-nociceptive and anti-inflammatory activities (Kassuya *et al.*, 2003) antidiabetic and antilipidemic potentials (Adeneye *et al.*, 2006a, b). *Phyllanthus amarus* has been reported to include antioxidant, antiviral, antibacterial, hypoglycemic, cancer suppressive and anthelmintic effects (Fig. 1). This study was aimed to present an overview of pharmacological, traditional and phytochemical investigations of bioactive compounds present in this plant.

### Taxonomy:

Kingdom : Plantae  
Division : Angiospermae  
Class : Dicotyledoneae  
Order : Tubiflorae  
Family : Euphorbiaceae  
Genus : *Phyllanthus*  
Species : *Amarus*



Fig. 1: *Phyllanthus amarus*

**Vernacular name:**

Hindi : Jamgli amla, Jaramla  
Malayalam : Kilarnelli, Kilukanelli  
Tamil : Kilanelli, Kilakkainelli  
Sanskrit : Bhumyamalaki  
Telugu : Nela usirika

**Habit and habitat:** A herb that grows upto 10-60 cm tall, erect, stem terete, younger parts rough, leaf 3.0-11.0×1.5-6.0 mm, elliptic oblong to ovate, Flowers axillary, proximal 2-3 axils with unisexual 1-3 male flowers and all succeeding axils with bisexual cymules. Male flowers -pedicel 1 mm long, calyx 5, oblong, elliptic, apex acute, hyaline with unbranched mid rib; disc segments 5, rounded, stamens 3, filaments connate. Female flowers-pedicel 0.8-1.0 mm long, calyx lobes 5, lobes often toothed at apex, styles 3, free, shallowly bifid at apex. seeds about 0.9 mm long, triangular with 6-7 longitudinal ribs and many transverse striations on the back (Bagchi *et al.*, 1992). It is widely spread throughout the tropics and subtropics in sandy regions as a weed in cultivated and wastelands (Ross, 1999).

**Traditional uses:** *Phyllanthus* has been used in Ayurvedic medicine for over 2,000 years and has a wide number of traditional uses. This includes employing the whole plant for jaundice, gonorrhoea, frequent menstruation and diabetes and using it topically as a poultice for skin ulcers, sores, swelling and itchiness. The plant is bitter, astringent, cooling, diuretic, stomachic, febrifuge and antiseptic. It is useful in dropsy, jaundice, diarrhoea, dysentery, intermittent fevers, diseases of urino-genital system, scabies ulcers and wounds. The young shoots of the plant are administered in the form of

an infusion for the treatment of chronic dysentery. Its efficacy in the field of gastro intestinal disorders like dyspepsia, colic, diarrhoea, constipation and dysentery is undisputed. In females it is used as a galactagogue, in leucorrhoea, menorrhagia and mammary abscess. In skin conditions, especially scabby or crusty lesions, bruises, wounds, scabies, offensive ulcers and sores, oedematous swellings, tubercular ulcers and ringworm, it has been utilized with good effect since many years. It is applied effectively in intermittent fevers and gonorrhoea as well as in ophthalmia and conjunctivitis. It has a urolithic property, dissolving renal calculi. Also, used in cough, asthma and other bronchial affections. It's antifungal, antiviral and anticancerous properties have also been demonstrated in experimental animals. The powdered leaves of *Phyllanthus amarus* (Bahupatra) were used in clinical studies evaluating its usefulness in patients suffering from chronic damage to the liver due to the protracted hepatitis B virus infection. This type of infection results in inability of the body's immune system to eliminate the virus from the liver cells. This condition is described as a carrier state, because a continuously harbors the virus. Some of the components of the virus detectable in the carrier state in the blood are: HBsAg or the surface antigen of the virus and HBeAg or the envelope antigen of the virus. In addition, the carrier state may be confirmed by the presence of antibodies directed against the core of the virus or the anti-HBc antibodies. The powdered leaves of *P. amarus* were given in form of capsules to the patients with chronic viral hepatitis B in a dose of 200 mg three times a day for 30 days. *P. amarus* treated patients tested negative for the viral antigen 15-20 days after the end of the treatment. Due to its antiseptic, styptic, carminative, deobstruent, coolant, febrifugal, stomachic, astringent and diuretic properties of this plant it is very much utilized in traditional medicine.

**Phytochemical properties:** *Phyllanthus amarus* primarily contains lignans (e.g., phyllanthine and hypophyllanthine) (Sharma *et al.*, 1993; Somanabandhu *et al.*, 1993) geraniin and 5 flavonoids (quercetin, astralgin, quercertrin, isoquercitrin and rutin). It also contains minor compounds like hydrolysable tannins like phyllanthusiin D (Houghton *et al.*, 1996), amariin (Foo, 1993) amarulone (Rao and Bramley, 1971), amarinic acid and alkaloids like ent-norsecurinine, sobubialine, epibubialine; diarylbutane, nyrphyllin and a neolignan, phyllinirurin.

**Pharmacological properties**

**Antioxidant activity:** The Total Phenolic Content (TPC) and antioxidant activity of fresh and dried

*Phyllanthus amarus* were evaluated by Folin-Ciocalteu method, 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity and Ferric Reducing Antioxidant Power (FRAP) assays. Different drying treatments led to significant reduction ( $p < 0.05$ ) in antioxidant properties of *P. amarus* methanolic extracts, with microwave drying causing the highest decrease in TPC and antioxidant activity exhibited by the reduction in both radical scavenging activity and FRAP, the boiling water extracts appeared to exhibit stronger antioxidant potentials ( $p < 0.05$ ) even in dried plant materials. This proves its strong free radical scavenging activity (Lim and Murtijaya, 2007).

**Anti-Inflammatory activity:** The Hexane Extract (HE), the Lignan-Rich Fraction (LRF), or the lignans phyltetralin, nirtetralin, niranthin of *P. amarus* when given orally inhibited carrageenan (Cg)-induced paw oedema and neutrophil influx. The HE, the LRF or nirtetralin also inhibited the increase of IL1- $\beta$  tissue levels induced by Cg. Bradykinin (BK)-, Platelet Activating Factor (PAF)- and endothelin-1 (ET-1)-induced paw oedema were significantly inhibited by the HE or LRF. Finally, nirtetralin or phyltetralin caused inhibition of paw oedema induced by PAF or ET-1. These results show that the HE, the LRF and the lignans niranthin, phyltetralin and nirtetralin exhibited marked anti-inflammatory properties (Kassuya *et al.*, 2005).

**Antinociceptive activity:** The Hydroalcoholic Extract (HE) of 4 *Phyllanthus* species, given intraperitoneally, produced significant inhibition of acetic acid-induced abdominal constrictions, with mean ID (50) values of 0.3, 1.8, 7.4 and 26.5 mg kg<sup>-1</sup> for *P. amarus*, *P. orbiculatus*, *P. fraternus* and *P. stipulatus*, respectively. In the formalin test, the 4 species produced graded inhibition against both phases of formalin-induced licking, being more active in relation of the late phase. The HE of the species elicited significant inhibition of the capsaicin-induced neurogenic pain. Orally all HE of the *Phyllanthus* species were less potent and efficacious than when given by intraperitoneally. This shows the pronounced antinociception when assessed in chemical models of nociception, namely acetic acid-induced writhing and formalin and capsaicin-induced licking (Santos *et al.*, 2000).

**Anti hepatotoxic activity:** Albino rats were treated with ethanol orally for 30 days and the control with sucrose. At the end of 30 days whole plant powder was administered at a dosage of 200 mg/rat/day for 45 days. The increased deposition of triglyceride, cholesterol and phospholipids

are reduced in liver, brain, kidney and heart due to ethanol administration (Tripathi *et al.*, 1992). Administration of whole plant powder for 7 days at dosage of 35 and 70 mg kg<sup>-1</sup> b.wt. helped in restoring the levels of biochemical parameters within next 48 h in calves (Sane *et al.*, 1995).

**Immunostimulant activity:** When albino rats were treated with the extract there is a dose-dependent decrease in Erythrocyte Sedimentation Rate (ESR) with 400 mg kg<sup>-1</sup> significant increase in Red Blood Cell (RBC) count (100 mg kg<sup>-1</sup>) and Packed Cell Volume (PCV). *P. amarus* did not affect the haemoglobin concentration, Total and differential count studies showed significant increases in the number of circulating leucocytes and neutrophils respectively especially with 100 mg kg<sup>-1</sup> of extracts ( $p < 0.05$ ). The aminotransferases (ALT) and (AST) gave significantly higher values in treated rats ( $p < 0.05$ ). It was therefore suggested that the plant can serve as an immunostimulant (Taiwo *et al.*, 2009).

**Antitumour and anticarcinogenic activity:** Aqueous extract of *P. amarus* exhibited potent anticarcinogenic activity against 20-methylcholanthrene induced sarcoma and increased the survival of tumour harboring mice. The extract administration (p.o.) was also found to prolong the life span of Dalton's Lymphoma Ascites (DLA) and Ehrlich Ascites Carcinoma (EAC) bearing mice and reduced the volume of transplanted solid tumours. The extract inhibited aniline hydroxylase, a P-450 enzyme. The concentration required for 50% inhibition (IC<sub>50</sub>) was found to be 540  $\mu$ g mL<sup>-1</sup>. The extract also inhibit DNA topoisomerase II of *Saccharomyces cerevisiae* mutant cell cultures and inhibited cell cycle regulatory enzyme cdc 25 tyrosine phosphatase (IC<sub>50-25</sub>  $\mu$ g mL<sup>-1</sup>). Antitumour and anticancer activity of *P. amarus* may be evident by the inhibition of metabolic activation of carcinogen as well as the inhibition of cell cycle regulators (Rajeshkumar *et al.*, 2002).

**Anti viral activity:** Alcoholic, hexane, chloroform, butanol and water extract of *P. amarus* were tested for *in vitro* effects on HbsAg, HBeAg and HBV-DNA in serum samples positive for HBV antigen followed by the screening of the respective antigen by Elisa. The extract were effective against HBV antigen, the butanol extract being the most potent (Mehrotra *et al.*, 1991). Further studies were conducted on mice infected with wood chuck hepatitis virus when administrated with extract was effective in three animals in reducing the virus within 3-6 weeks eliminating both the surface antigen titer and DNA polymerase activity in serum. Venkateswaran *et al.*

(1987). An aqueous extract on human hepatocellular carcinoma derived cell at 1 mg mL<sup>-1</sup> concentration on a single dose. Inhibition of the secretion of HBsAg for a period of 48 h was observed (Jayaram and Thyagarajan, 1996; Yeh *et al.*, 1993). Disruption of hepatitis B virus polymerase activity, mRNA transcription and replication supported the role of *Phyllanthus amarus* being used as an antiviral agent (Lee *et al.*, 1996; Ott *et al.*, 1997).

**Antibacterial activity:** The antibacterial activity of extracts of the root and leaf was assessed against extend spectrum lactamase (ESBL) producing *Escherichia coli* isolated from the stool samples of HIV sero-positive patients using Bauer disc diffusion method. The strains isolated from both HIV sero-positive patients were susceptible to various concentrations of the extracts (5, 10, 20, 40 and 80 mg mL<sup>-1</sup>). This proves the antibacterial activity of the extract (Akinjogunla *et al.*, 2010).

**Hepatoprotective, nephroprotective and cardio protective activity:** The methanol extract of *Phyllanthus amarus* leaves (50-800 mg kg<sup>-1</sup>) caused a statistically significant (p<0.05 student's t-test) decrease in the levels of total cholesterol, AST, ALT, urea, uric acid, total protein, prostatic, alkaline and acid phosphatases. The highest reduction effect was obtained with uric acid at 400 mg kg<sup>-1</sup> of *P. amarus* extract while the least effect was observed in total cholesterol. These effects were dose- and time-dependent. This shows that the leaves of *P. amarus* have hepatoprotective, nephroprotective and cardio protective properties (Obianime and Uche, 2008).

**Anti hyper glycemc activity:** In a clinical trial conducted on nine mild hypertensive patients (Diabetes Mellitus) were treated with a preparation of the whole plant of *Phyllanthus amarus* for 10 days. The observations indicated that *Phyllanthus amarus* as a potential diuretic hypotensive and hypoglycaemic drug for human. Blood glucose was significantly reduced in the treated group (Srividya and Periwal, 1995). In another trial 25 patients in the age group of 35 - 55 with moderate and severe diabetic blood sugar level (250-400 mg/100 mL) showed statistically significant (p<0.05) lowering of blood sugar levels at a dose of 1 g thrice daily for a period of 3 months (Sivaprakasam *et al.*, 1995).

## CONCLUSION

The present study shows the pharmacological, traditional and phytochemical properties of various

bioactive compounds present in the plant. The whole plant is used in India for the treatment of various diseases. The antioxidant potential of the extracts can be assessed by employing different *in vitro* assays. The antibacterial activity of extracts of the root and leaf was assessed against extend spectrum lactamase. Antitumour and anticancer activity of *P. amarus* may be evident by the inhibition of metabolic activation of carcinogen as well as the inhibition of cell cycle regulators. The whole plant powder helped in restoring the levels of biochemical parameters. *P. amarus* posses various phytochemical and pharmacological properties as discussed in present study. Further more Clinical and Pathological studies should be conducted to investigate the active potentials of bioactive compounds present in this plant.

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