

Phytochemical, pharmacological potential and ethnomedicinal uses on *Phyllanthus amarus*: A review

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Abstract

Ethnomedicinal plants are especially important for human health by prevention of various human diseases. One of such ethno medicinal plant species which used, widely to *Phyllanthus amarus*. *Phyllanthus amarus* belongs to family Euphorbiaceae. Stone breaker, Gala of wind, Bhumi Amla, Jangli Amla and carry me seeds are called unique name of this plant. It is popular in aboriginal system of medicine like Siddha, Ayurveda, and Unani homeopathy and is used for its antidiabetic, antitumor, hepatoprotective, antihypertensive, and analgesic, anti - inflammatory and antimicrobial properties. This plant is used in diarrhoea, intermittent fevers, cold, jaundice, dropsy and has used as a good anti - viral activity against hepatitis-B virus. The whole plant of *Phyllanthus amarus* is rich store house of several types of phytochemicals such as quercetin, geraniin, phyllanthin, hypophyllanthin, rutin, norsesquiterpene etc. *Phyllanthus amarus* has also served for various experimental investigations that detailed its pharmacological uses and phytochemical constituents. The present review compiles ethnomedicinal uses phytochemical and pharmacological properties of *Phyllanthus amarus*.

Keywords: Ethnomedicine; Phytochemical; Pharmacology; *Phyllanthus amarus*; Analgesic

1. Introduction

Those plants that are commonly used in treating and preventing specific ailments and that are harmful to human beings may be called as medicinal plants WHO (world health organization) estimates that about 80% of these people depends upon ethno-medicines for their primary healthcare needs, that means more than 3.3 billion people in the underdeveloped countries utilize medicinal plants on a regular basis [1]. The name "*Phyllanthus*" means "Leaf and flower" and named so because of its flower, fruit and leaf appears fused [2]. The higher the amount of phytoconstituents in medicinal plants, the greater therapeutic potency of the plants [3]. *Phyllanthus amarus* is one of the ancient ethnomedicinal plants cultivated its highly priced fruits and other parts. The *Phyllanthus amarus* belongs to family Euphorbiaceae. It is one of the largest genera of flowering plants consists of about 800 species. Their range of habits are annual or biennial herbs, shrubs, and trees. These plants are found throughout the tropical and subtropical regions of both the hemisphere. Various species of *Phyllanthus amarus* are taken into consideration to be highly effective and rich in phytochemicals compounds used as food, cosmetic and food industry. Various phytochemical has been conducted on *Phyllanthus* species such as Lignans, terpenes, flavonoids, Coumarins, alkaloids. The phytochemical lignans of the genus namely, phyllanthin and hypophyllanthin and have been shown to be antihepatotoxic against carbon tetrachloride and galactosamine induced hepatotoxicity. The genus *Phyllanthus* is the most important plants marketed as in India [4]. *P. amarus* is commonly called as stone - breaker, wind - breaker, gulf leaf flower, gala of wind and carry me seed [5]. Ravikant et al, reported that the southern region of India is genetic hotspot & *Phyllanthus* species [6]. The genus *Phyllanthus* contains 1000 species and cover over tropical and sub-tropical continents like Asia, America, Africa, and

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Australia [7]. Unani literature described that the “Bhuti” means Bhum Amlak, Amla of Land [8]. The folk medicine of *P. amarus* used to treat diarrhoea, diabetes, otitis, swelling skin ulcer, jaundice, blocks DNA polymerase in hepatitis-B Virus during reproduction and gastrointestinal disturbances [9]. In Ayurveda, it is reported by Sanskrit name - Bhloodha tree, Taam alakee, Bhoomy aamlakee [10]. It is used in the Indian Ayurveda system of medicine in various problems like liver, stomach-ache, kidney, spleen, genitourinary system. It is an important medicinal plant because of its antiviral activity against hepatitis-B virus and various biological activities like kidney, gall bladder, stones, cold, flu, tuberculosis, liver disease etc. [11].

2. Systematic Position

- Kingdom- Plantae
- Division - Angiospermae
- Class- Dicotyledoneae
- Order- Tubiflorae
- Family - Euphorbiaceae,
- Genus- Phyllanthus
- Species- amarus

2.1. Vernacular Names

Odia Language - Bhumia amla, Bhuiaola.

Telugu Language- Nela Urika

Hindi- Jangli amla, Hindi bhimi amla

English - stone breaker, Shatter stone, Hurricane weed, Gulf leaf flower, Gale of wind, carry me seed, Black catnip

Sanskrit - Bhloodha tree, Tamalakee, Bhoom yaamlake

Bengali- Bhui amla

Tamil- Keelanelli (Keezhanelli)

2.2. Botanical characteristics

P. amarus is an annual herb, glabrous and 10-60 cm tall. Its roots are woody and stout. Stems are angular and branched at base. Leaves are compound, sub - sessile, paripinnate, stipulate, and distichous. Leaflets are obscure and base rounded. Flowers are pedicellate, axillary and yellowish fruit is minute, glabrous, capsule and dehiscent. Fruit is present in underneath the branches. The seeds are pale brown with parallel ribs on the back side and trigonous. The stalked capsule are 1-2mm long smooth, round, 2 mm wide with six seeds. *P. amarus* plant has explosive seed that propel the seeds far from the plant [12].

Plant parts Used: Stems, seeds, fruits, Leaves, and whole plants & *P. amarus* are used [13, 14].

2.3. Phytoconstituent of *P. Amarus*

P. amarus is reported to contain many chemical constituents like lignans, phyllanthin, hypophyllanthin, nirphyllin and phyllinurin; Flavanone glycoside such as niranthin, nirtetralin, phylltetralin and lintetralin; steroid hormone estradiol, triterpenes like phyllantheol, phyllanthene, and phyllanthanol; flavanoids such as quercetin, quercitrin, and astragalin [15-19].

2.4. Pharmacological Potential

The pharmacological potential of *P. amarus* have reported several types of pharmacological properties like anti-inflammatory, anti - plasmodial, diuretic, hepatoprotective, anti - cancer, anti - oxidant, anti-Viral, antimicrobial etc. of new drugs of all plants are still poorly explored and a little percentage has been investigated its phytoconstituents and their pharmacological properties. [Table - 1].



Figure 1 Leaf, Tree & Fruit of *Phyllanthus Amarus*

Table 1 Pharmacological potential of major phytoconstituents of *P. amarus*

Sl No	Class	Phytoconstituents and its pharmacological effect
1	Flavonoid	- Rutin and its pharmacological effects are Reproductive [20] and Antioxidant [21]. - Quercetin-3-0-glucoside and its pharmacological effect is antioxidant [22]
2	Tannins	- Geraniin and its pharmacological effects are antiviral radio- protective [23] ,Hepatoprotective [24] - Amariin and its pharmacological effects are hepatoprotective [25], radioprotective and anti-oxidant. - Repandusinic acid - A and its pharmacological effects are radioprotective and Antioxidant. - Corilagin and its pharmacological effects are Antiviral, Antioxidant and Radioprotective. - Phyllanthusiin A, B, C, D, and its pharmacological effects are antioxidant [21] and radio protective.
3	Alkaloid	Norsecurinine and its pharmacological effect is Antifungal [26].
4	Volatile Oils	Linalool and Phytol and its pharmacological effect is Anti – microbial [27].
5	Lignans	Phyllanthin and its pharmacological effects are Hepatoprotective [28], Anticancer, Antitumor [29], Antibacterial, Antiamnestic Antiaging, Antioxidant, and Anti- inflammatory, Anti – apoptotic. Hypophyllanthin and its pharmacological effects are Anti - tumour, anticancer [30]. Niranthin, and its pharmacological effects are Antitumor [31] , Anti – viral, and Anti – inflammatory. phyltetralin and its pharmacological effects Anti – inflammatory. Nirtetralin and its pharmacological effects are Anti- inflammatory [32], Antiviral, and reverse multidrug resistance [33]. Hinokinin and its pharmacological effects is antiviral.

2.5. Structure of Major Phytoconstituents

The structural forms of important phytoconstituents present in *Phyllanthus amarus* are given below:

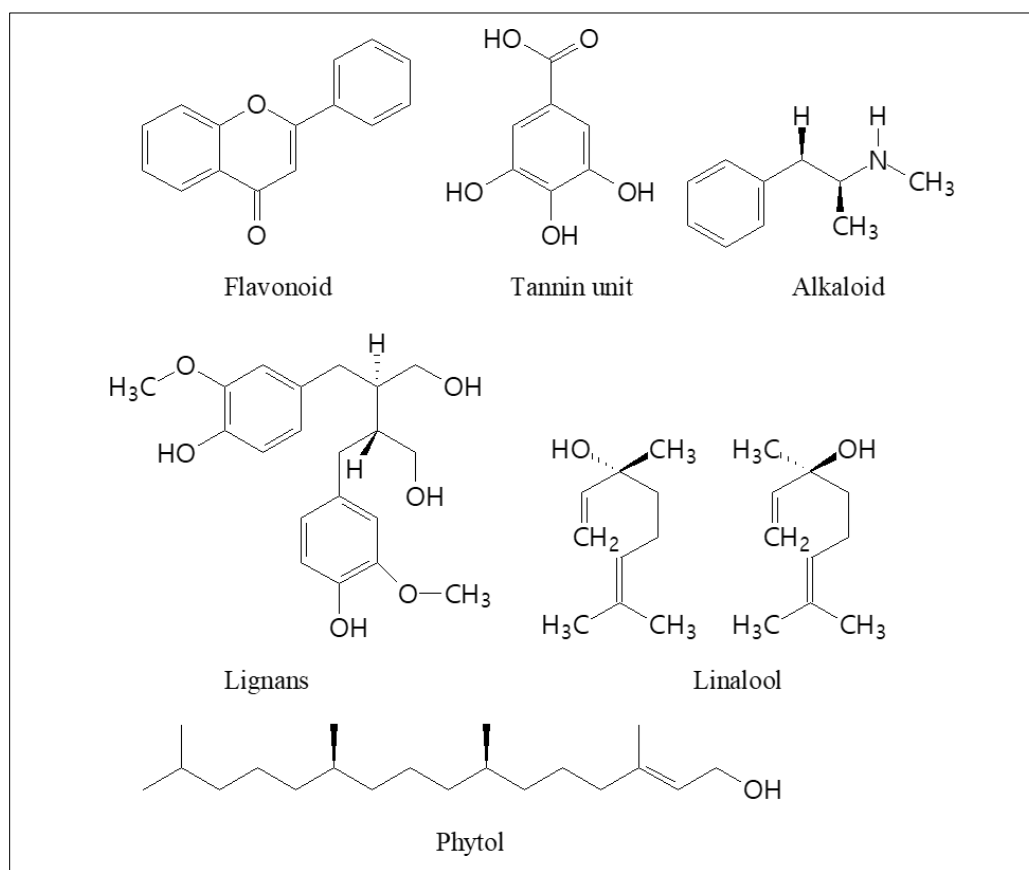


Figure 2 Important Phytoconstituents of *Phyllanthus amarus*

3. Pharmacological Activity

3.1. Antiviral activity

An aqueous extract of Bhui-amla plant inhibits endogenous DNA polymerase of hepatitis B virus as well as binds to the antigen of hepatitis B virus in vitro [34]. Bhui amla exhibit antiviral activity against HIV [35] as well as used as antiviral effect against dengue fever [36]. Thus, plant reveal more antiviral activity against Herpes Simplex Virus type - 1 and Herpes Simplex virus type - 2 which is anticipated to its action in the early stage of replication and infection [37].

3.2. Anti - diabetic Activity

The ethanolic lead extract (400mg / kg body weight) of *P.amarus* (400 mg/kg body weight) are taken orally for 45 days resulted in blood - glucose and increase in the activity of glucokinase in the liver of diabetic mice [38]. The methanolic extract of *P. amarus* was resulted to reduce the blood sugar in alloxan diabetic rats by 6 % at a dose level of 200 mg/kg body weight and 18.7% reduction in blood sugar [39]. Hydroalcoholic extract of *P. amarus* used in African - nation for treating diabetes and many other diseases, 500 mg / kg (two doses) of each extract were taken orally to diabetic rats. Simultaneously, liquid and hydroalcoholic extract of *P. amarus* reduces blood sugar levels after 15 days of administration [40].

3.3. Hepatoprotective activity

The aqueous extract of *P. amarus* shows hepatoprotective effect on ethanol- induced rat hepatic injury [41]. It is reported that aqueous extract of *P. amarus* at the dose of 50 or 100mg/kg body weight for 7 days against nimesulide induced hepatic damage showed hepatoprotective effect [42]. The aqueous extract of *P. amarus* seeds and methanolic at the dose of 250 mg / kg body weight found protective effect, in-vitro and in-vivo models of against CCl₄ mediated liver injury [43].

3.4. Anti-venom activity

The combination of *Andrographis paniculata* plant and extract of *P. amarus* possess potent venom neutralizing capability and used for therapeutic functions in case snake bite. The extracts of Di-herbal possess effectively neutralized cobra snake venom induced lethal activity. The di-herbal plant extract (about 0.24 mg) is fully able to neutralize the lethal activity of 2 LD₅₀ of genus *N. naja* Venom [44].

3.5. Antimicrobial Activity

It is reported that the methanolic extract of *P. amarus* found antimicrobial activity against all gram +ve and gram -ve bacteria responsible for urinary tracts and gastrointestinal tracts and common infections of skin. The large therapeutically potential has showed by antimicrobials of plant origin and are highly effective in the treatment of infectious diseases. They are simultaneously alleviating many side effects and relate to artificial antimicrobials [45].

3.6. Anti-inflammatory Activity

The alcohol extract of *P. amarus* showed anti- inflammatory activities were examined and Leprosy, Urinary disorders, and asthma. *P. amarus* is containing of many bioactive compounds such as niruricide , ricinolic acid , steroids , phenyl propanoids , triterpines , ellagitannins , glycosides , tannins ,alkaloids ,flavonoids , hypothyllanthin , Phyllanthin , Lignans etc. *P. amarus* is used in ethnomedicine for treating gall bladder stone, kidney stone, liver disease such as Jaundice and Liver cancer. Further *P. amarus* is also used in treatment for scabby, crusty lesions, ring worm, tubercular ulcers, scabies , wounds, skin issues such as Ulcers , sores , swelling and itchiness , diarrhoea, dysentery , dropsy , intermittent fevers , gonorrhea, diabetes, and chronic infections .

3.7. Anti - cancerous activity

It is reported that and the extract of *P. amarus* was shown to be capable of apoptosis-(Inducing Programmed cell death) with its anti-metastatic action, 3-fold increase of caspases - 3 and -7 presence of DNA fragmentation and terminal deoxynucleotidyl transferase enzyme mediated dUTP nick end labelling assay (TUNEL) -positive cells. The anti - metastatic activity is associated to the presence of polyphenol compounds in its extracts.

3.8. Antioxidative Activity

The 2, 2 - diphenyl picrylhydrazyl (DPPH) assay is used to determine to antioxidant potential which is a based-on reduction of stable radical DPPH to yellow colored DPPH. *P. amarus* have powerful antioxidant property. It has been found that the boiled water extract of fresh dried *P. amarus* plant had comparatively greater antioxidant activity than microwave assisted extraction method employed for the extraction.

3.9. Antileptospiral Activity

Human meet with the infected animal's urine or urine contaminated environment is called Leptospirosis which is globally important disease. *P.amarus* have been looked for the antileptospiral activity by micro dilution tests and tube dilution technique and results revealed the inhibitory action of methanolic and extract of whole plant *P. amarus* against leptospira.

3.10. Cardioprotective and Nephroprotective Activity

Cardioprotective and Nephroprotective activity of *P. amarus* is evident from the study on which methanol extract of *P. amarus* leave caused a significant dose dependent decrease in the levels of total cholesterol , ALT (Alanine transaminase) ,AST(Aspartate transaminase) Alkaline and Acid Phosphatase , Uric acid and prostatic , total cholesterol, urea, total protein increase in these enzymes are related to heart disorders therefore their reduction shows that *P. amarus* leaves have cardio protective and nephroprotective properties

4. Conclusion

Now-a-days the use of ethnomedicinal plants increased globally due to lesser side effects. *P. amarus* is one of the utmost needed, ethnomedicinal plants for the treatment of different diseases. *P.amarus* are found in secondary metabolite and are several factors for various pharmacological activities. The pharmacological studies have demonstrated that the extract of *P. amarus* plant possess many pharmacological activities viz, Antiviral, Anti- diabetic, hepatoprotective, Antivenom, Antimicrobial, Anti-inflammatory, Anti-cancerous, Anti-oxidative, antispiral, cardioprotective and nephroprotective activity. Further his plant extracts have been evaluated in human trial for treatment of HIV hypertension and jaundice etc. The current evidence is more limited to correlation between identified phytochemicals

and its mode of action for any pharmacological activity. The extract of *P. amarus* could be further explored in the future as a useful phytoconstituents for the pharmaceutical industry. However, conservation and optimum utilization of *P. amarus* - medicinal herbs are also a challenge and requisite to the stakeholders for betterment of humanity.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflicts of interest.

References

- [1] Davidson-Hunt I. Ecological Ethnobotany: Stumbling toward New Practices and Paradigms. *MASA J.* 2000; 16:1–13.
- [2] Kumar S, Choudhary H, Seniya C. In Vitro Antibacterial Study of Aqueous and Methanolic Extracts of Some Selected Medicinal Plants. *Journal of Chemical and Pharmaceutical Research.* 2011; 3:854.
- [3] Danladi, S, Ma Idris, and Ii Umar. "Review on Pharmacological Activities and Phytochemical Constituents of *Phyllanthus Niruri* (Amarus)." *The Journal of Phytopharmacology* 7, no. 3 (June 18, 2018): 341–48. <https://doi.org/10.31254/phyto.2018.7318>.
- [4] Patel, Jay Ram, Priyanka Tripathi, Vikas Sharma, Nagendra Singh Chauhan, and Vinod Kumar Dixit. "Phyllanthus Amarus: Ethnomedicinal Uses, Phytochemistry and Pharmacology: A Review." *Journal of Ethnopharmacology* 138, no. 2 (November 2011): 286–313. <https://doi.org/10.1016/j.jep.2011.09.040>.
- [5] Ved DK, Goraya GS. *A Textbook of Demand and Supply of Medicinal Plants in India*. NMPB, New Delhi and FRLHT, Bengaluru, India, 2008.
- [6] Ravikant G, Srirama R, Senthilkumar U, Ganeshiah KN, Umashaanker R. Genetic Resources of *Phyllanthus* in Southern India: Identification of Geographic and Genetic Hot Spots and Its Implication for Conservation. *Phyllanthus Species: Scientific Evaluation and Medicinal Applications*, 2011, 97-118.
- [7] Sadiq Wada, Abubakar, Sa'adatu Muhammad Julde, Safiya Bala Borodo, Mubarak Hussaini Ahmad, Sani Malami, and Abdullahi Hamza Yaro. "Phytochemistry, Ethnomedicinal Uses and Pharmacological Activity of *Diodia Scandens*; a Review of Current Scientific Literature." *Egyptian Journal of Basic and Applied Sciences* 9, no. 1 (December 31, 2022): 533–41. <https://doi.org/10.1080/2314808X.2022.2098462>.
- [8] Lee, Nathanael Y S, William K S Khoo, Mohammad Akmal Adnan, Tanes Prasat Mahalingam, Anne R Fernandez, and Kamalan Jeevaratnam. "The Pharmacological Potential of *Phyllanthus Niruri*." *Journal of Pharmacy and Pharmacology* 68, no. 8 (July 4, 2016): 953–69. <https://doi.org/10.1111/jphp.12565>.
- [9] Patel JR, Tripathi P, Sharma V, Chauhan NS and Dixit VK. *Phyllanthus Amarus: Ethnomedicinal Uses, Phytochemistry and Pharmacology: A Review*. *Journal of Ethnopharmacology*, 2011;138:286-313.
- [10] Unander DW, Herbert HB, Connete JL and Robert TM. Cultivation of and Evaluation of Variable Potentially Affecting Yield and the Inhibition of Viral DNA polymerase. *Economic Botany*, 1993;47:79-88. 10. Morton J F: *Atlas of Medicinal Plants of Middle America*. Library of Congress Cataloging in Publication Data, Thomas Books, 1981, 1420.
- [11] Ito E, Ukana D, Ekaete D. Phytochemical Screening and Nutrient Analysis of *Phyllanthus Amarus*. *Asian Journal of Plant Science and Esearch*, 2013;3:116-122.
- [12] Bimbima. <http://Www.Bimbima.Com/Health/Post/2013/09/04/Medicinal-Use-Bhui-Amla-Tamalaki.AspX>. 23 Nov. 2014.
- [13] Dhongade H, Chandewar AV. Pharmacognostical, Phytochemical, Pharmacological Properties and Toxicological Assessment of *Phyllanthus Amarus*. *Interational Journal of Biomedical and Advance Research* 2013; 4(5):NA.

- [14] Houghton PJ, Woldemariam TZ, Siobhan OS, Thyagarajan SP. Two Securinega Type Alkaloids from *Phyllanthus Amarus*. *Phytochemistry*. 1996; 43:715–717.
- [15] Kassuya CA, Silvestre A, Menezes-de-Lima Jr O, Marotta DM, Rehder VL, Calixto JB. Antiinflammatory and Antiallodynic Actions of the Lignan Niranthin Isolated from *Phyllanthus Amarus*. Evidence for Interaction with Platelet Activating Factor Receptor. *European Journal of Pharmacology* 2006; 546:182-188.
- [16] Foo LY. Amariin a Di-Dehydro Hexahydroxy Diphenoyl Hydrolysable Tannin from *Phyllanthus Amarus*. *Phytochemistry* 1993; 33:487–491.
- [17] Maciel MAM, Cunha A, Dantas FTNC, Kaiser CR. NMR Characterization of Bioactive Lignans from *Phyllanthus Amarus* Schum & Thonn. *Journal of Magnetic Resonance Imaging* 2007; 6:76–82.
- [18] Obianime W, Uche FI. The Phytochemical Screening and the Effects of Methanolic Extract of *Phyllanthus Amarus* Leaf on the Biochemical Parameters of Male Guinea Pigs. *J Appl Sci Environ Manage* 2008; 12(4):73–77.
- [19] Londhe JS, Devasagayam TPA, Foo LY, Ghaskadbi SS. 'Radio Protective Properties of Polyphenols from *Phyllanthus Amarus* Linn,' *Journal of Radiation Research*, 2009:50(4):303-309.
- [20] Londhe JS, Devasagayam TPA, Foo LY, Ghaskadbi SS. 'Antioxidant Activity of Some Polyphenol Constituents of the Medicinal Plant *Phyllanthus Amarus* Linn,' *Redox Report*, 2008:13(5):199-207.
- [21] Foo LY. Amarinic Acid and Related Ellagitannins from *Phyllanthus Amarus*. *Phytochemistry*, 1995:39:217-224.
- [22] Kandhare AD, Ghosh P, Ghule AE. 'Protective Effect of *Phyllanthus Amarus* by Modulation of Endogenous Biomarkers and DNA Damage in Acetic Acid Induced Ulcerative Colitis: Role of Phyllanthin and Hypophyllanthin,' *Apollo Medicine*, 2013:10(1):87-97.
- [23] Londhe JS, Devasagayam TPA, Foo LY. 'Geraniin and Amariin, Ellagitannins from *Phyllanthus Amarus*, Protect Liver Cells against Ethanol Induced Cytotoxicity,' *Fitoterapia*, 2012:83(8):1562-1568.
- [24] Notka F, Meier G and Wagner R. 'Concerted Inhibitory Activities of *Phyllanthus Amarus* on HIV Replication in Vitro and Ex Vivo,' *Antiviral Research*, 2004:64(2):93-102.
- [25] Sahni S, Maurya S, Singh UP, Singh AK, Singh VP, Pandey VB. Antifungal Activity of nor-Securinine against Some Phytopathogenic Fungi. *Mycobiology*, 2005:33:97-103.
- [26] Moronkola DO, Ogunwande IA, Oyewole IO, Husnu Can Bas K, Ozek T, Ozek G. 'Studies on the Volatile Oils of *Momordica Charantia* L. (Cucurbitaceae) and *Phyllanthus Amarus* Seh. et Thonn (Euphorbiaceae),' *Journal of Essential Oil Research*, 2009:21(5):393-399.
- [27] Chirdchupunseree H, Pramyothin P. 'Protective Activity of Phyllanthin in Ethanol-Treated Primary Culture of Rat Hepatocytes,' *Journal of Ethnopharmacology*, 2010:128(1):172-176.
- [28] Islam A, Selvan T, Mazumder UK, Gupta M, Ghosal S. 'Antitumour Effect of Phyllanthin and Hypophyllanthin from *Phyllanthus Amarus* against Ehrlich Ascites Carcinoma in Mice,' *Pharmacologyonline*, 2008:2(2):796-807.
- [29] Krithika R, Mohankumar R, Verma RJ. Isolation, Characterization and Antioxidative Effect of Phyllanthin against CCl₄-Induced Toxicity in HepG2 Cell Line," *Chemico-Biological Interactions*, 2009:181(3):351-358. 2009.
- [30] Kassuya CAL, Silvestre A, Menezes-de-Lima O, Marotta DM, Rehder VLG, Calixto JB. 'Antiinflammatory and Antiallodynic Actions of the Lignan Niranthin Isolated from *Phyllanthus Amarus*. Evidence for Interaction with Platelet Activating Factor Receptor,' *European Journal of Pharmacology*, 2006: 546(1-3):182-188.
- [31] Kassuya CAL, Leite DFP, Melo LV De, Rehder VLC, JB, Calixto JB. 'Anti-Inflammatory Properties of Extracts, Fractions and Lignans Isolated from *Phyllanthus Amarus*,' *Planta Medica*, 2005: 71(8):721-726.
- [32] Dhir H, Kumar Roy A, Sharma A, Talukder G. 'Protection Afforded by Aqueous Extracts of *Phyllanthus* Species against Cytotoxicity Induced by Lead and Aluminium Salts,' *Phytotherapy Research*, 1990:4(5):172-176.
- [33] Venkateswaran PS, Millman I, Blumberg BS. Effects of an Extract from *Phyllanthus Niruri* on Hepatitis B Andwoodchuck Hepatitis Viruses: In Vitro and in Vivo Studies. *Proc Nati Acad Sci USA* 1987; 84:274-278.
- [34] Naik AD, Juvekar AR. Effects of Alkaloidal Extract of *Phyllanthus Niruri* on Hiv Replication. *Indian Journal of Medical Sciences* 2003; 57(9):387-394.
- [35] Lee SH, Tang YQ, Rathkrishnan A, Wang SM, Ong KCH, Manikam R et al. Effects of Cocktail of Four Local Malaysian Medicinal Plants (*Phyllanthus* Spp.) against Dengue Virus 2. *BMC Complementary and Alternative Medicine* 2013; 13(192):1-13.

- [36] Tan W, Jaganath I, Manikam I. Evaluation of Antiviral Activities of Four Local Malaysian Phyllanthus Species against Herpes Simplex Viruses, and Possible Antiviral Target. International Journal of Medical Sciences 2013; 10(13):1817-1892.
- [37] Shetti AA, Sanakal RD, Kaliwal BB. Antidiabetic Effect of Ethanolic Leaf Extract of Phyllanthus Amarus in Alloxan Induced Diabetic Mice. Asian Journal of Plant Science and Research, 2012;2:11-15.
- [38] Raphael KR, Sabu MC, Kuttan R. Hypoglycemic Effect of Methanol Extract of Phyllanthus Amarus Schum and Thonn. On Alloxan Induced Diabetes Mellitus in Rats and Its Relation with Antioxidant Potential. Indian Journal of Experimental Biology, 2002;40:905-909.
- [39] Evi PL, Degbeku K. Antidiabetic Activity of Phyllanthus Amarus Schum and Thonn on Alloxan Induced Diabetes in Male Wistar Rats. Journal of Applied Sciences, 2011;11:2968-2973.
- [40] Pramyothin P, Ngamtin C, Pongshompoo S, Chaichantipyuth C. Hepatoprotective Activity of Phyllanthus Amarus Schum Thonn Extract in Ethanol Treated Rats: In Vitro and in Vivo Studies. Journal of Ethnopharmacology 2007; 114(2):169-173.
- [41] Chatterjee M, Sil PC. Hepatoprotective Effect of Aqueous Extract of Phyllanthus Niruri on Nimesulide Induced Oxidative Stress in Vivo. Indian Journal of Biochemistry & Biophysics 2006; 43; 299-305.
- [42] Syed Asad B, Iqbal MM, Kiranmai M, Ibrahim M. Hepatoprotective Activity of Phyllanthus Amarus Seeds Extracts in CCl₄ Treated Rats: In Vitro & In Vivo. Global Journal of Medical Research 2012; 12(6):39-49.
- [43] Sornakumar RSA, Kunthavai PC, Gnaniah S. Isolation, Purification and Characterization of Active Compound from Andrographis Paniculata L. and Phyllanthus Amarus Linn. And Testing the Antivenom Activity of the Di-Herbal Extract by in-Vitro and in-Vivo Studies. International Research Journal of Pharmacy, 2014;5:207-211.
- [44] Sen A, Batra A. Determination of Antimicrobial Potentialities of Different Solvent Extracts of the Medicinal Plant: Phyllanthus Amarus Schum. And Thonn. International Journal of Green Pharmacy, 2012;6:50-56.
- [45] Ibrahim D, Hong LS, Kuppan N. Antimicrobial Activity of Crude Extract Methanolic Extract from Phyllanthus Niruri. Nat. Prod. Communicatin, 2013;8(4):493-496.

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