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A REVIEW ON PHYTOCHEMICAL AND PHARMACOLOGICAL PROPERTIES OF *PHYLLANTHUS AMARUS* SCHUM.AND THONN.

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ABSTRACT: For over three thousand years, people have used Phyllanthus amarus Schumann and Thön as a medicinal plant.It is a member of the Euphorbiaceae family and goes by many names, including carrymeseed, stonebreaker, galaofwind, and others.and so on.It is a weedy perennial plant that grows in the tropics and subtropics and is 30–60 cm tall.Because it includes various combinations of secondary metabolites, Phyllanthus amarus is gaining traction for its therapeutic characteristics, which include hepatoprotective, anti-carcinogenic, anti-bacterial, anti-viral, anti-inflammatory, and more activities. Varied classes of bioactive chemicals have been identified and isolated, including alkaloids, flavonoids, lignans, sterols, tannins, triterpenes, and volatile oils. The leaves of P. amarus were used to extract ligans such as phyllanthin and hypophyllanthin, as well as flavonoids like quercetin.Due to the complex combination of substances found in the extract at trace concentrations, this study makes an ongoing attempt to portray the phytochemicals and their pharmacological characteristics.

Keywords: *Phyllanthusamarus*, Phytochemicals,Pharmacological activity,Traditionaluses

INTRODUCTION:

When it comes to raw herbal remedies, the Phyllanthus genus is among the most prominent in India. 1. Phyllanthus is a tropical and subtropical genus with over a thousand species that may be found in the Americas, Africa, Australia, and Asia. Phyllanthus amarus is a common weed in both agricultural and urban areas of India.

Phyllanthus species may be found in all three of the most common types of vegetation: trees, shrubs, and herbs. According to Ravikant et al., southern India is the epicenter of Phyllanthus species' genetic diversity. 5. The therapeutic properties of Phyllanthus amarus Schum. and Thonn. have led to its long history of human use.

Belongs to a big family of plants that may grow either erect or prostrate; its milky, acidic juice is a common moniker. 6. The term 'Bhuti,' meaning 'BhumAmlak-AmlaofLand' in Unani literature, describes it.

7. It's a key component in creating eco-friendly medications, which are less harmful and more reliable than expensive synthetic pharmaceuticals. The Sanskrit names Bhoomy-aamlakee, Taamalakee, and Bhoodha tree are some of the Ayurvedic terms for P. amarus. 8. The unique antiviral action of P. amarus against hepatitis B virus and for several other biological activities, including kidney and gallbladder stones, the common cold, flu, TB, liver illnesses, etc., is causing P. amarus uses to gain speed. 9. Local Names: The plant is recognized by many local names in different locations (Table 1). It goes by several names: gust of wind, leaf flower, stone breaker, wind breaker, and bring me seed. 10. Phyllanthus derives its name from the fact that its three main parts—flower, fruit, and leaf—appear to be merged together.

TABLE1:NAMESUSEDWORLDWIDEOF*P.AMARUS*AREASFOLLOWS[8,12]

S.no.	Language	VernacularNames
1	Hindi	Bhumiamla,Jangliamli
2	English	Blackcatnip,Carrymeseed,Childpick-a-back,Galeofwind, Gulfleafflower,Hurricaneweed,Shatterstone,Stonebreaker
3	Tamil	Keelanelli(Keezhanelli)
4	Bengali	Bhuiamla
5	Rajasthani	Gugario
6	Oriya	Bhuiaola
7	Telugu	Nelaurika
8	Kannada	Nela-nelli,Kirunelli
9	Malayalam	Kilanelli
10	Sanskrit	Bhoomyaamlakee,Bhoodhatree,Tamalakee
11	French	Poudredeplomb(ivorycoast)
12	America	Yerbadelanina[10],Chancapiedra[13],Hurricaneweed
13	Spanish	Yerbamagica

Botanical Characteristics: *Phyllanthus amarus* is a branching annual glabrous herb which is 30 - 60 cm high and has slender leaf bearing branchlets, distichous subsessile leaves with elliptic-oblong, obtuse, rounded base (**Fig. 1**). Flowers are axillary and yellowish, whitish or greenish. Male flowers are in groups of 1 - 3 whereas females are solitary. Fruits are depressed-globose like smooth capsules present underneath the branches and seeds are trigonous, pale brown with longitudinal parallelribs on the back [14]. Capsules on stalks are 1 - 2 mm long, round, smooth, 2 mm wide six seeds. The plant has explosive seed capsules that propel the seeds some distance from the plant. Seeds are triangular, light brown, 1 mm long with 5 - 6 ribson the back [10,15].

FIG.1:*PHYLLANTHUSAMARUS*FOUNDINRAJASTHANINITSHABITAT

Distribution: *P. amarus* is a common pantropical weed that grows well in moist, shady and sunny places. It is widely spread throughout tropics and subtropics [11,16]. The taxonomic revision of genus *Phyllanthus* by Webster included closely-related genera *P. amarus*, under the sub-section Swartiziani of the section *Phyllanthus*. The nomenclature, taxonomic distinctness and close relatives of *P. amarus* were addressed in detail based on morphology and geographical distribution [17-19]. It is said to be related to *P. abnormis*, which is endemic to sandy areas in Texas and Florida of southern USA.

It is, therefore, most likelythat *Phyllanthus amarus* originated in the Caribbean area as a vicarious species of *P. abnormis* of the southern UnitedStates and has spread around the tropics by trading vessels [17]. Among approx. 1000 species of genus Phyllanthus, 53speciesarefoundinIndia, ofwhich

23 species are endemic. These are distributed throughout the Indian subcontinent, with higher densities in the southern region. Among 53 species of Phyllanthus, 37 are shrubs, 13 are herbs and 3are trees [20].

Jain*etal*.,2003assessedthemoleculardiversityof *P. amarus* across India using RAPD (random amplified polymorphic DNA) markers. The genetic variability was assessed across 33 locations covering the states of Tamil Nadu, Karnataka, Maharashtra, Gujarat, Assam, West Bengal, Tripura, Uttar Pradesh, Punjab and Haryana. Intra population variation was larger in accessions from southern India compared to other parts of the country. *P. amarus* grows wildly in all drier partsof Rajasthan [21].

Phytochemical Properties: Phytochemistry is regarded as the heart of herbal therapy and the phytochemical research plays an important role in the development of green medicines, which are safertouse(**Table2**).Themajorclassofbioactive

TABLE2:PHYTOCHEMICALSPRESENTIN*P.AMARUS*

compounds like alkaloids, flavonoids, lignans, phenols,tannins,terpenesandvolatileoilshasbeen isolated. These bioactive compounds furtherinclude their respective phytoconstituents. Alkaloids possess securinine, nor-securinine, epibubbialine,isobubbialine,dihydrosecurinine[22,23]. Flavonoids contain Quercetin, kaempferol, astragalin,quercetin-3-O-glucoside, quercitrin [10,13,24-26]. Likewise, Tannins include Amarulone, geraniin, amariin, furosin, corilagin, melatonin, phyllanthusin D [13,24,25].Lignans contains important pharmacological activities because of its phyto-constituents such as Phyllanthin, hypo-phyllanthin, 5-dimethoxy-niranthin, nirtetralin, phyltetralin, hinokinin, 4-(3,4-dimethoxy-phenyl)-1-(7-methoxy benzo[1,3]dioxol-5-yl)-2,3-bismethoxymethyl-but--an-1-ol[10,23,27,28,29,30,31,32].Sterolsinclude Amarosterol A, amarosterol B [33].Triterpenes like Phenazine and phenazine derivatives, 2Z, 6Z, 10Z, 14E, 18E, 22E-farnesyl farnesol [24,30] and volatile oils such as Linalool, Phytol [34].

S. no.	Secondary Metabolite	Structural Definition	SomeImportant Phytochemicals	References
1.	Alkaloids	Alkaloidsareagroupofnaturallyoccurring nitrogenousorganiccompoundsofplant origin.	Securinine,nor-securinine, epibubbialine,isobubbialine, dihydrosecurinine.	22,23
2.	Flavonoids	Flavonoids are polyphenolic molecules containing15carbonatomsandaresoluble in water.	Quercetin,kaempferol,astragalin, quercetin-3-O-glucoside, quercitrin.	10,13,24-26
3.	Tannins	Tanninisapolyphenolicbiomoleculethat binds to precipitate proteins and various otherorganiccompoundslikeaminoacids and alkaloids.	Amarulone,geraniin,amariin, furosin, corilagin, melatonin, phyllanthusin D.	13,24,25
4.	Lignans	Plant lignans are also polyphenolic compoundsderivedfromphenylalaninevia dimerization of substituted cinnamic alcohols.	Phyllanthin, hypo-phyllanthin, 5-dimethoxy-niranthin, nirtetralin, phyltetralin, hinokinin, 4-(3,4-diethoxy-phenyl)-1-(7-methoxybenzo[1,3]dioxol-5-yl)-2,3-bismethoxy methyl-butan-1-ol	10,23,27-32
5.	Sterols	Phytosterols, which encompass plant sterolsandstanols,arephytosteroidsimilar to cholesterol which occur in plants and vary only in carbon side chains and/or presenceorabsenceofadoublebond.	AmarosterolA, amarosterolB.	33
6.	Triterpenes	Triterpenes are a class of chemical compoundshavingthreeterpeneunits with themolecularformulaC30H48orconsists of six isoprene units.	Phenazineandphenazinederivatives, 2Z, 6Z, 10Z, 14E, 18E, 22E-farnesylfarnesol.	24,30
7.	VolatileOils	Avolatileoilisaconcentrated hydrophobic liquidcontainingvolatilearomacompounds from plants.	Linalool, Phytol.	34

Ethno-pharmacological Uses: If the selection of plants is made on the grounds of their traditional use, the chance of research success is greater [35]. This herb is in traditional medicine for more than 3000 years [36].

- *Phyllanthus amarus* herb has found its traditional uses in several health problems because of its efficacy in the field of gastrointestinal disorders [37].
- It is used in several female problems such as in leucorrhoea, menorrhagia and mammary abscess and can act as galactagogue [38].
- Fresh leaf paste has the capacity to cure white spots on skin, diabetes, and jaundice [39-42].
- Wholeplantextractisusedinurinaryproblems, liver disease, dyspepsia, anorexia, constipation and dysentery [43,44].
- Gonorrhea and syphilis can be treated by a decoction of leaves, sugar and cumin seeds [45].
- Treatment of malaria has been successful by *P. amarus* whole plant extract [46].

It is an ingredient of the most popular formulations ofAyurveda-Chyawanprash,whichisconsumedat largescalenot onlyin Indiabut also throughout the world because of its anti-inflammatory activity [47].

Pharmacological Activities: Plants as a source of new drugs are still poorly explored of all plant species. Only a small percentage has been investigated phytochemically and even a smaller percentage has been properly studied in terms of their pharmacological properties [48].

Antioxidant Activity: Because of its ability to reduce lipid peroxidation and scavenge hydroxyl and superoxide radicals in-vitro, a methanolic extract of P. amarus was shown to possess potential antioxidant activity. The quantities needed to scavenge hydroxyl and superoxide radicals were 117 and 19 mg/ml, respectively, whereas 104 µg/ml was the quantity that inhibited lipid peroxide generation by 50%. The antioxidant capabilities of the methanolic extracts of P. amarus were significantly reduced ($P<0.05$) by various drying methods. Microwave drying resulted in the greatest drop in total phenolic content (TPC) and antioxidant activity, as shown by the decrease in both radical scavenging activity and free radical absorbing polyphenol (FRAP). However, because of the increased

solubility of chemicals, the breakdown of cellular components, and the hydrolysis of tannins, boiling water extracts showed noticeably enhanced antioxidant potentials ($P<0.05$) even in dried plant materials.

Several systems, including DPPH, 2,2-azobis- 3-ethylbenzthiazoline-6-sulfonic acid (ABTS)/ferritin, ferric reducing antioxidant power (FRAP), and pulse radiolysis, were used to assess the antioxidant activity of the main ingredients, which included amariin, 1-galloyl-2,3- dehydrohexahydroxydiphenyl (DHHDP)-glucose, repandusinic acid, geraniin, corilagin, phyllanthusiin D, rutin, and quercetin 3-O-glucoside.

Depending on the tests used, the compounds' antioxidant activity varied in terms of how effective they were. Phyllanthusiin D, amariin, and repandusinic acid were the ellagitannins with the highest antioxidant activity, but they were on par with the flavonoids rutin and quercetin 3-O-glucoside 26. Extracts from P. amarus seem to have the same gastro-protective effects as cimetidine and to function as a natural antioxidant in vivo. It is also possible that Phyllanthus amarus may protect the liver from the harmful effects of alcohol.The aerial sections of P. amarus were subjected to silica gel column chromatography using gradient elution with a solvent combination of hexane and ethyl acetate in order to extract phyllanthin, one of the active lignins found in the plant.

Elements, Fourier transform infrared spectroscopy, nuclear magnetic resonance, circular dichroism spectroscopy, mass spectrometry, and ultraviolet-visible spectroscopy were used to characterize Phyllanthin. Phyllanthin and P. amarus extract were also tested for their ability to scavenge free radicals using the DPPH assay. Cell viability was dramatically reduced by the CCl_4 treatment. The effects of phyllanthin on CCl_4-induced alterations were shown to be concentration-dependent and much less than those of Phyllanthus amarus extract 52.

After 8 weeks of treatment with P. amarus aqueous extract (PAAEt) at a dosage of 200 mg/kg body weight/day, rats were tested for oxidative stress and antioxidant status using a battery of tests, including lipid peroxidation (LPO), vitamin C, uricacid, reduced glutathione (GSH), and the enzymes glutathione peroxidase (GPx), catalase (CAT), and superoxide dismutase (SOD). Plasma levels of vitamin C, uric acid, glutathione (GSH), and the enzymes GPx, CAT, and SOD were all significantly higher in rats treated with PAAEt, but plasma levels of LPO were significantly lower in these animals.

As compared to other extracts and even in-vivo plant extraction, the methanol extract of P. amarus. exhibited the highest antioxidant activity and the highest amount of phenolic compounds, as determined by free radical scavenging activity evaluated using the DPPH (1,1-diphenyl-2-picrylhydrazyl) method in an in-vitro callus. 54.

Efficacy against diabetes: At a dosage of 200 mg/kg body weight, the methanolic extract of P. amarus lowered blood sugar levels in rats with alloxan diabetes by 6%, while at a dose of 180 mg/kg body weight, it reduced blood sugar levels by 18.7%. 49. Togo's aqueous and hydroalcoholic P. amarus extract has anti-diabetic and anti-diabetic effects. Both extracts were given orally to diabetic rats at two dosages, 500 and 1000 mg/kg. As a result, after 15 days of treatment with an aqueous or hydroalcoholic P. amarus extract, blood glucose levels drop considerably (55). According to research conducted by Shetti, diabetic mice showed a significant improvement in their blood glucose control and an increase in glucokinase activity in the liver after 45 days of oral treatment of an ethanolic leaf extract at a dose of 400 mg/kg body weight. 56.

The medicinal potential of antimicrobials derived from plants is enormous. They work well against infectious infections and have few of the negative side effects associated with synthetic antimicrobials. 57. Some fungi (Alternaria brassicae, Alternariasolani, Curvularia pennisetti, Curvularia sp., Erysiphe pisi, Helminthosporium frumentacei, and E. pisi) and their spore germination processes were investigated in vitro using nor-securinine, an alkaloid extracted from Phyllanthus amarus. Fungal sensitivity to nor-securinine was quite variable. Against the majority of the fungus, nor-securinine showed efficacy. The effectiveness of pre-inoculation

therapy in suppressing powdery mildew was higher than that of post-inoculation treatment. evolution on glasshouse pea plants. At 2000 µg/mL 58, the level of inhibition was at its highest.

Keflex, Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli, Proteus mirabilis, and Enterococcus faecalis were the six intestinal organisms that were found and isolated. To test for antibacterial activity, we utilized both broth dilution and agar diffusion. Due to the fact that sub-cultivation produced growth on all plates except one containing K. pneumoniae, Phyllanthus amarus demonstrated bacteriostatic activity at this concentration. Among all the microbes tested, the alcoholic P. amarus extract had the widest zone of inhibition and the lowest inhibitory concentration. In contrast to petroleum ether, which had a lower inhibitory concentration and a smaller minimum zone of inhibition, the water-based P. amarus extract was less effective against all of the test pathogens. The disc diffusion technique, as reported by Boer et al., 15, was used for the antimicrobial analysis.

Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, and Candida albicans were used to assess the antibacterial and antifungal properties of the crude extract and fractions. While the hexane, ethyl acetate, and aqueous methanol fractions did not exhibit any activity against the organisms, the dichloromethane fraction exhibited activity against all of the test species with MIC at 100 µg/ml. According to the antifungal investigation, the fractions are effective against Candida albicans.Following 21 days of incubation at 37°C, no organisms grew on the plates.This provides further evidence that the fraction has anti-Candida albicans activity. This agrees with an earlier study by Foo and Wong (1992: 13).

An indication of their therapeutic potential in the therapy of UTI is the strong antibacterial activity of the ethanol extracts of the P. amarus and P. niruri against E. coli. When it comes to P. amarus's anti-microbial status, the results obtained in this experiment are in agreement with those of earlier writers (61–63). Extracts from both P. amarus and P. niruri inhibited growth of four out of five E. coli strains. A possible remedy for UTI 64 might be an infusion or decoction of one of the two plants.

Results showed that niranthin, nirtetralin, hinokinin, and geraniin at a non-cytotoxic concentration of 50 µm effectively suppressed the expression of HBsAg and hepatitis B effective antigen (HbeAg). Of these compounds, niranthin exhibited the best anti-HBsAg activity, and the most potent anti-HBeAg activity was observed with hinokinin 65. The study concluded that these compounds had anti-viral activity. After incubating hairy roots of P. amarus in vitro with HbsAg-positive sera for 24 hours at 37 °C, the in vitro culture was shown to have an 85% inhibition (compared to 15% in the control) in binding of Hepatitis B Surface Antigen (HBsAg) to its antibody, anti-HBs. 66. At a dosage of 150 mg/kg of body weight for 30 days, the aqueous extract of P. amarus exhibited moderate antiviral efficacy against white spot syndrome virus in shrimp 67. Testing the impact on viral RNA replication was done using Taq Man Real time RT-PCR. In in vitro tests, P. amarus root extract significantly inhibited the HCV-NS3 protease enzyme, whereas P. amarus leaf extract significantly inhibited NS5B. Findings may provide light on the molecular mechanisms behind P. amarus extract's inhibitory action against HCV, opening the door to the potential optimization and eventual creation of a targeted antiviral drug derived from this powerful natural source. 68.

The methanolic extract of P. amarus hairy roots exhibited strong antiproliferative effects in MCF-7 cells, which were attributed to the activation of apoptosis via an increase in intracellular reactive oxygen species (ROS) and a reduction in mitochondrial membrane potential (69). The effects of an aqueous extract of the whole plant of P. amarus on the oxidative toxicity in vitro of Cr (VI) in MDA-MB-435S human breast cancer cells showed that the cytotoxicity inflicted by Cr (VI) decreased noticeably as the dose of the extract increased. Its phenolic components may concurrently protect MDA-MB-435S cells against Cr (VI)-induced oxidative stress. 70.

Along with its antimetastatic impact, Phyllanthus amarus was shown to induce apoptosis; this was accompanied by a threefold rise in caspases 3 and 7, the presence of

cells that were positive for DNA-fragmentation and the terminal deoxynucleotidyl transferase nick end labeling test (TUNEL). Phyllanthus amarus extracts are thought to include polyphenol chemicals, which are responsible for the plant's antimetastatic effects. 71. Activity against venom: A combination of plant extracts from Phyllanthus amarus and Andrographis paniculata has the ability to neutralize snake venom and might be utilized as a treatment for snakebite envenomation. The deadly activity caused by cobra venom was successfully mitigated by di-herbal plant extracts. It is possible to fully counteract the deadly effects of 2 LD50 of N. naja venom with around 0.24 mg of di-herbal plant extract. "Fertility Effect" (72).

Traditional healers have long held the belief that the aerial portions of the Phyllanthus amarus plant may increase a man's fertility. Testosterone levels are raised by Phyllanthus amarus leaf extract, but LH and FSH levels are either not affected or just slightly affected. Because a healthy amount of testosterone is necessary for adult men to have a normal sex desire and an increase in spermatozoa, this rise may be the reason of an uptick in male fertility. Section 74: Infertility in Women An alcoholic extract of the whole plant of P. amarus was administered orally to cyclic adult female mice at a dosage of 100 mg/kg body weight for a duration of 30 days. There was found to be no discernible shift in absolute body and weights of several organs and even metabolism in general. Because of an interference with their cyclicity, 75 percent of the female mice who lived alongside normal male mice were sterile. However, in female mice, it has caused the abortion of a few unborn offspring. Researchers set out to determine if an aqueous extract of P. amarus leaf (AEPA) had any effect on the success of fertilization and subsequent pregnancy. The treated rats' implantation time was shortened and the pregnant rats' abortion rates were increased by AEPA. The traditional idea that the aqueous extract of Phyllanthus amarus may cure infertility is unsupported by its abortifacient action, even if it shortens the time frame for implantation 76.

Inhibition of LPS-induced generation of NO and PGE2 was seen in the ethanol, aqueous, and hexane extracts of Phyllanthus amarus, indicating anti-inflammatory activity. Tumor necrosis factor (TNF) release caused by LPS was also reduced by the extracts. The expression of iNOS and COX-2 was decreased and the activation of NF-κB was blocked by both extracts, however AP-1 was not affected. In humans, P. amarus lowered TNF-α production in vivo and blocked the induction of IL-1β, IL-10, and interferon-γ in whole blood.The consequences of P's methanol extract. the effects of amarus on various stages of inflammation were investigated. To study this, researchers in rats used a variety of phlogistic chemicals to cause swelling in the paws, carrageenan to inflame the air pouch, and cotton pellet granuloma. In contrast to histamine-induced paw edema, the methanol extract of Phyllanthus amarus effectively reduced carrageenan, bradykinin, serotonin, and prostaglandin E1-induced paw edema. Granulomatissue development was considerably reduced in chronic inflammatory model 78 by the extract.

TABLE3:PHARMACOLOGICALACTIVITIESREPORTEDIN*P.AMARUS*BYVARIOUSAUTHORS

S. no.	Pharmacological Activity	WorkDone	Place	Ref.
1	Anti-oxidant Activity	Hypoglycemiceffectofmethanolextractof *Phyllanthusamarus*Schum andThonnonalloxaninduceddiabetesmellitusinratsanditsrelationto antioxidant potential.	Thrissur(India)	49
		Anti-oxidantpropertiesof*Phyllanthusamarus*extractsasaffectedby different drying methods.	Malaysia	50
		Antioxidantactivityofsomepolyphenolconstituentsofthemedicinal plant *Phyllanthusamarus* Linn.	Pune, Mumbai (India),NewZealand	26
		Gastroprotectiveandantioxidantactivitiesof*Phyllanthusamarus*extracts on an absolute ethanol-induced ulcer in albino rats.	Nigeria	51
		Isolation,CharacterizationandAnti-oxidativeeffectofPhyllanthinagainst CCl_4-induced toxicity in HepG2 cell line.	Ahmedabad,Chennai (India)	52
		Theanti-oxidantpotentialofaqueousextract of *P.amarus*inrats.	Anantapur(India)	53

		Determinedthefreeradicalscavengingpropertiesfordifferent*in-vivo*and *in-vitro*plantextraction of*P.amarus.*	Jaipur (India)	[54]
2	Anti-diabetic Activity	Hypoglycemiceffect of methanolextract of *Phyllanthusamarus*Schum andThonnonalloxaninduceddiabetesmellitusinratsanditsrelationto antioxidant potential.	Thrissur(India)	[49]
		Antidiabeticactivityof*Phyllanthusamarus*SchumandThonnonalloxan induced diabetes in male wistar rats.	Togo, France	[55]
		Antidiabeticeffectofethanolicleafextractof*Phyllanthusamarus*in alloxan induced diabetic mice.	Dharwad(India)	[56]
3	Antimicrobial Activity	Antifungalactivityofnor-securinineagainstsomephytopathogenicfungi.	Varanasi(India)	[58]
		Determinationofantimicrobialpotentialitiesofdifferentsolventextractsof the medicinal plant: *Phyllanthus amarus* Schum. and Thonn.	Jaipur (India)	[59]
		BiologicalandChemicalEvaluationoftheExtractsoftheLeafof *Phyllanthusamarus* Schum.	Nigeria	[60]
		Antibacterialattributesofextractsof*Phyllanthusamarus*and*Phyllanthus niruri* on *Escherichia coli* the causal organism of urinary tract infection.	Nigeria	[64]
4	Anti-viral Activity	Screeningof25compoundsisolatedfrom*Phyllanthus*Speciesforanti- human hepatitis B virus *in-vitro*.	Taiwan	[65]
		Developmentofapotent*invitro*sourceof*Phylanthusamarus*rootswith pronounced activity against the surface antigen of the hepatitis B virus.	Kolkata(India)	[66]
		ScreeningtheantiviralactivityofIndianmedicinalplantsagainstWhite spot syndrome virus in shrimp.	Vellore (India)	[67]
		InhibitionofhepatitisCvirusreplicationbyherbalextract:*Phyllanthus amarus* as potent natural source.	Bangalore(India)	[68]
5	Anti-cancer Activity	Hairyrootextractof*Phyllanthusamarus*inducesapoptoticcelldeathin human breast cancer cells.	Mumbai(India)	[69]
		Aqueousextractof*Phyllanthusamarus*inhibitschromium(VI)-induced toxicity in MDA-MB-435S cells	Vellore (India)	[70]
		Anti-metastaticeffectsof*Phyllanthus*onhumanlung(A549)andbreast (MCF-7) cancer cell lines. PLoS ONE 6, e20994.	Malaysia	[71]
6	Anti-venom Activity	Isolation, purification, and characterization of active compound from *Andrographispaniculata*Linn.and*Phyllanthusamarus*L.andtestingthe ani-venomactivityofthe di-herbal extract by*in-vitro* and *in-vivo* studies.	Chennai (India)	[72]
7	FertilityEffect			
7a	Fertilityinmale	ThePhytochemicalconstituentsandtheeffectsofmethanolextractsof *Phyllanthusamarus* leaves(kidneystoneplant)onthehormonal parametersofmaleguineapigs.	Nigeria	[73]
7b	Anti-fertility in female	Contraceptiveeffectsof*Phyllanthusamarus*infemale mice.	Ahmedabad(India)	[75]
		Effectofaqueousextractof*Phyllanthusamarus*leavesonimplantationand pregnancy in rats.	Nigeria	[76]
8	Anti-inflammatory Activity	*Phyllanthusamarus*hasanti-inflammatorypotentialbyinhibitionofiNOS, COX-2, and cytokines via the NF-κB pathway.	Germany	[77]
		Evaluationofanti-inflammatoryactivityofmethanolextractof*Phyllanthus amarus* in experimental animal models	Mumbai	[78]

CONCLUSION:

P. amarus is attracting many researchers since many decades because of its potent pharmacological uses, which is discussed above like jaundice, diabetes, syphilis, dysentery, fever, gonorrhea, *etc*. Every country has their own traditional use of *P. amarus* but the way of curing disease is almost common everywhere. Theextracts of the plant possess various activities like anti-viral, anti-diabetic, anti-hepatoxic, antibacterial, antifungal and anti-inflammatory. This can be of great use for identifying more alternatives to cure different diseases. As this plant grows in tropical and sub-tropical areas, consequently in countries like India, Nigeria and Malaysia, more research work is continued. The aim of this review was to gather the research work undertaken till date in order to provide enough baseline for future works.

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