Review Article

The Genus *Phyllanthus*: An Ethnopharmacological, Phytochemical, and Pharmacological Review

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The plants of the genus *Phyllanthus* (Euphorbiaceae) have been used as traditional medicinal materials for a long time in China, India, Brazil, and Southeast Asian countries. They can be used for the treatment of digestive disease, jaundice, and renal calculus. This review discusses the ethnopharmacological, phytochemical, and pharmacological studies of *Phyllanthus* over the past few decades. More than 510 compounds have been isolated, the majority of which are lignins, triterpenoids, flavonoids, and tannins. The researches of their remarkable antiviral, antioxidant, antidiabetic, and anticancer activities have become hot topics. More pharmacological screenings and phytochemical investigations are required to support the traditional uses and develop leading compounds.

1. Introduction

*Phyllanthus* (Euphorbiaceae) is a large genus and widely distributed in tropical and subtropical zones like tropical Africa, tropical America, Asia, and Oceania. This genus, consisting of more than 700 species, can be classified into 11 subgenera [1, 2]. The most popular 24 species are chiefly belonging to subgenus *Kirganelia*, *Cicca*, and *Phyllanthus* and they are traditionally used by different nationalities.

Genus *Phyllanthus* has been employed as herbal drugs for a long time in China, India, Brazil, and Southeast Asian countries. The most abundant species are used in India and have a beneficial role in Ayurveda for the treatment of digestive, genitourinary, respiratory, and skin diseases [3, 4]. In China, herbs and their prescriptions are used to treat hepatitis B, hypertension, dropsy, and sore throat [2]. These herbal drugs are employed by local inhabitants of Thailand, Latin America (especially Brazil), and Africa to cure jaundice, renal calculus, and malaria, respectively [5–7].

By virtue of the wide uses of *Phyllanthus* as anti-HIV, anticancer, and anti-HBV agents, there has been considerable interest in the investigations of this genus in recent years and the researches about pharmacology and chemistry had been finished in a deep going way. This report reviews the ethnopharmacological, phytochemical, and pharmacological investigations of *Phyllanthus* over the past few decades. More than three hundred articles were selected from the data taken from SciFinder Scholar database by searching the keyword “Phyllanthus”.

2. Ethnopharmacological Uses

The traditional application experiences of these herbs may have reference value for the treatment of recent diseases. Botanical data, folk name, and medicinal properties of twenty-four *Phyllanthus* species are depicted in Table 1. In Asia, seventeen plants are considered to have bitter and astringent taste. They are regarded as stomachic, diuretic, febrifuge,
The leaves of "bhuiaveli," "pancoli," and "harfarauri," respectively. The information as remedies for diabetes, jaundice, wound, fever, and inflammation. Additionally, these herbs can be employed as therapy of urinary disease and have the names "bhuiamlki" [29]. The fruits of "bhuiamlki" are employed by indigenous medicine. These plants have bitter and astringent taste and are considered as stomachic, diuretic, deobstruent, and antiseptic agents and effective remedies for hepatopathy, hypertensive, diabetes, and jaundice. In Africa, six herbs are widely employed by many tribes for the treatment of malaria wound and tetanus. Six species are used extensively in Latin America for the treatment of urination disorder and diabetes. The distribution and the main uses of Phyllanthus are pictured in Figure 1.

2.1. Asia. In Asia, the clinical use of genus Phyllanthus is very prevalent. The fruit of P. emblica has a long history of use in India and is called "amla" or "Indian gooseberry." As a tonic in Indian Ayurveda, it is often used for liver diseases [3, 4]. This fruit is known as "yuganji" in China. It has sweet and slightly astringent taste and is used for clearing heat from throat and moistening lung for arresting cough in Traditional Chinese Medicine (TCM). In Tibetan medicine this herb is used to treat blood and bile disease, and its preparations are clinically applicable to hypertension and anuria [2]. In Thailand, it is named "makhampom" and is employed to treat gastrointestinal chronic diseases. P. emblica is commonly used together with Terminalia chebula and T. bellerica and called "Triphala." "Triphala" is used as a clinical treatment protocol of gastropathy in India and as a remedy for pestilence and fatigue in China [62].

In India, fifteen species of genus Phyllanthus are widely used by indigenous medicine. These plants have bitter and astringent taste and are considered as stomachic, diuretic, febrifuge, deobstruent, antiseptic, and effective remedies for hepatopathy. Some herbs such as P. niruri, P. amarus, P. fraternus, P. debilis, and P. maderaspatensis share the same name “bhuiamlki” [29]. The fruits of “bhuiamlki” are employed by Ayurveda to cure jaundice. P. simplex, P. reticulatus, and P. aci dus are therapy of urinary disease and have the names of “bhuiaveli,” “pancoli,” and “harfarauri,” respectively. The leaves of P. polyphyllus, called "sinurelli," are used for liver disease. Additionally, the rest of these herbs can be employed as remedies for diabetes, jaundice, wound, fever, and inflammation.

In China, five herbs are commonly used by TCM, Tibetan medicine, Dai People, and Yi People [2]. They have bitter and sweet taste and are usually used as prescriptions. The whole plant of P. urinaria, known as "yexiazu," can clear heat-toxin and remove dampness and is employed to treat jaundice, enteritis, diarrhea, and dropsy. Besides, the TCM prescription, named “yexiazu capsule,” performs a beneficial role in curing hepatitis B. Other herbs such as P. reticulatus, P. niruri, and P. simplex are beneficial to the treatment of ophthalmopathy, urinary infection, inflammation, and rheumatism.

In Thailand, eight herbs of this genus are widely used by residents. P. amarus, P. urinaria, and P. virgatus share the name “look tai bai,” all of which are used for treating gonorrhea, jaundice, diabetic, and liver disease. P. acidus has three names: “otaheiti gooseberry,” “star gooseberry,” and “mayom,” and it can be used as remedy for hypertensive, constipation, skin disease, and fever. The rest of herbal drugs including P. taxodifolius, P. niruri, and P. reticulatus are employed for the treatment of urination disorder and malaria.

2.2. Africa. Many African tribes employ six plants of genus Phyllanthus to treat malaria, fever, and wound. P. muellerianus is the most popular herbal drugs of this genus in Africa. It is named “mbolongo” in Cameroon. In Ghana and Cameroon, the stem bark is used for the therapy of wound and tetanus. In Nigeria, Zambia, and Ivory Coast the leaves and root are applied as a fever remedy. In Kenya, the root of P. polyanthus is used to cure sexually transmitted diseases. What is more, the whole plants of P. muellerianus and P. reticulatus can be used for the treatment of malaria.

2.3. Latin America. About six herb species of this genus are used in many countries in Latin America. In Brazil, P. tenellus is popularly known as “quebra-pedras” whose leaves can be used as diuretic. P. amarus is named “chanca piedra” in Peru and the leaves are employed for diabetic and jaundice therapy or as sedative and astringent. P. sellowianus is called “sarandi blanco” in South America and used widely in folk for the treatment of urination disorder and diabetes.

In summary, P. emblica, P. reticulatus, and P. niruri are the top three species widely used around the world. P. niruri is probably the most widespread herb of Phyllanthus, which is named “chanka piedra,” “bhuiamlki,” “zhuzicao,” “dukung anak,” “quebra-pedra,” and “chanca piedra.” Its whole plant can treat inflammation, lithiasis, fever, malaria, hepatitis, and gonorrhea [7, 18, 19, 21, 22].

3. Chemical Constituents

More than 510 compounds have been isolated from Phyllanthus, the majority of which are lignins, triterpenoids, flavonoids, and tannins. The compositions isolated from each species and their biological activities are partially summarized in Table 2. Lignins and tannins exhibit various activities and are considered to be the biological active compounds of this genus. Corilagin, geraniin, and gallic acid are three most prevalent compounds in this genus, and the pharmacological researches mainly focus on phyllanthin, niranthin, and geraniin.
| Species  | Region          | Local name        | Plant part used | Traditional use                                                                 | Reference |
|----------|-----------------|-------------------|-----------------|---------------------------------------------------------------------------------|-----------|
| Phyllanthus emblica | Bangladesh | Fruit | Constipation, urinary diseases | [8] |
|           | Burma | Juice/bark | Constipation, hemostasis, keratitis | [8] |
|           | Cambodia | Leaves | Muscle pain, fever | [8] |
|           | China | Yuganzi | Fruit | Digestive disease, hypertension, fever, respiratory inflammation | [8] |
|           | Fiji | Fruit | Tonic | [8] |
|           | India | Amla, Indian gooseberry | Fruit | Diabetes, chronic diarrhea, inflammation, fever, liver diseases, stomach ulcers, metabolic disorders, skin disorders, beauty care | [3, 4] |
|           | Indonesia | Leaves/fruit | Diarrhea, abdominal pain, stomach Disease, gallbladder disease, bleeding | [8] |
|           | Iran | Fruit | Parasitic | [8] |
|           | Iraq | Stem/fruit/seed | Urination disorder, constipation, bleeding, diarrhea, ophthalmopathy, asthma, bronchitis | [8] |
|           | Nepal | Fruit | Bleeding, gastrointestinal system disorder | [8] |
|           | Pakistan | Fruit | Diarrhea, preterm, skin diseases, gonorrhea, ophthalmopathy, anemia, hair care | [8, 9] |
|           | Sri Lanka | Fruit/whole plant | Constipation, indigestion, keratitis | [8] |
|           | Thailand | Makhampom | Juice/bark | Diarrhea, leukorrhagia, cough, parasitosis, gastrointestinal chronic diseases, hair treatment and nourishment, skin care | [8, 10, 11] |
|           | Turkey | Fruit | Diarrhea, dysentery, hemostasis, gastroenteritis | [8] |
| Phyllanthus reticulatus | Bangladesh | Whole plant | Edema, constipation, helminthiasis, dysentery, diarrhea, pain | [12] |
|           | China | Huangguo yexiazu | Inflammation, rheumatism | [13] |
|           | India | Pancoli, karineli | Urination disorder, fever, smallpox, colic, constipation, diabetes | [12, 14, 15] |
|           | Kenya | Stem/bark | Malaria | [7] |
|           | Malaysia | Leaves | Smallpox, syphilis, asthma, diarrhea, bleeding from gums, diabetes, urination disorder, sores, burn, suppuration, chafe, venereal sores | [16, 17] |
|           | Sri Lanka | Bark/fruit | Enterosis, urination disorder | [15] |
|           | Sudan | Stem/bark | Urination disorder, fever | [15] |
|           | Tanzania | Whole plant/leaves | Dysmenorrhea, gonorrhea, urination disorder, intestinal hemorrhage and anemia, muscle spasms, diarrhea with anal bleeding, promoting fertility, sores | [12, 15] |
|           | Thailand | Whole plant/leaves | Urination disorder, asthma, anemia, fever, thirst, astringent, inflammation | [16] |
| Phyllanthus niruri | Brazil | Quebra-pedra | Whole plant | Kidney calculi | [18] |
|           | China | zhuzicao | Whole plant | Hepatitis, dysentery, enteritis, urinary infection | [19] |
|           | Congo | Whole plant | Malaria | [20] |
|           | India | Chanka piedra, bhuiamliki | Fruit/whole plant | Bronchitis, anaemia, leprosy, asthma, kidney calculi, ulcer, wound, sore, scabies, ring worm, jaundice, gonorrhea, menstruation, diabetes | [18, 21–23] |
|           | Indonesia | Whole plant | Viral infection, hepatitis | [22] |
|           | Latin America | Chanka piedra | Whole plant | Gallstone, kidney calculi, fever, excess uric acid | [6, 18, 24] |
|           | Malaysia | Dukong anak | Whole plant | Diarrhoea, kidney disorder, gonorrhea, cough | [22] |
|           | Thailand | Aerial parts | Anorexia, malaria | [18] |
| Phyllanthus muellerianus | Angola | Mbolongo | Stem bark | Malaria | [25] |
|           | Cameroon | Leaves | Wound, tetanus | [26] |
|           | Ghana | Root | Wound | [27] |
|           | Nigeria | Leaves | Fever | [26] |
|           | Zambia | Leaves | Fever | [26] |
| Species       | Region     | Local name       | Plant part used | Traditional use                                                                 | Reference |
|--------------|------------|------------------|-----------------|---------------------------------------------------------------------------------|-----------|
| *P. amarus*  | Africa     | Whole plant      | Urinary concretions, dysentery, jaundice, diarrhoea, Gasopathy, diarrhoea, dysentery, intermittent fevers, ophthalmopathy, scabies, ulcers, wound, malaria, jaundice, diabetes, asthma, hepatitis, tuberculosis, urinary diseases, bodyache, immunomodulatory | [28]      |
|              | India      | Bhuiamiki        | Whole plant     | Diabetes mellitus, obesity, hyperlipidemia, malaria                               | [29-34]  |
|              | Nigeria    | Chanca piedra    | Leaves          | Diabetes, jaundice, kidney diseases, urination disorder, sedative, astringent, tonic | [35, 36] |
|              | Thailand   | Look tai bai     | Leaves          | Gonorrhea, jaundice, diabetes, liver diseases                                     | [37]      |
|              | India      | Whole plant      | Kidney calculi, painful disorder, jaundice, enteritis, diarrhea, dropsy, inflammation | [38-41]  |
|              | India      | Harfarauri       | Fruit/leaves/roots | Jaundice, constipation, vomiting, biliousness, urinary concretions, piles, fever, smallpox, rheumatism, asthma, hepatic disease, diabetes, gonorrhea, ophthalmopathy, amnesia, psoriasis | [42, 43] |
|              | Thailand   | Otaheiti gooseberry, star gooseberry, mayom | Leaves/bark/root | Constipation, alcoholic addicts, hypertension, fever, dermatitis, menstruation fever | [44-46]  |
|              | India      | Bhuamiki         | Swelling, intestinal worms, fever, wound, inflammation, rheumatism | [34]      |
|              | Sri Lanka  | Bhuamiki         | Diabetes        | [47]      |
|              | China      | Huang zhuziao    | Leaves/whole plant | Ophthalmopathy, gonorrhea, jaundice, mammary abscess, pruritus, diarrhoea, hepatitis, urinary infection | [48, 49] |
|              | Cameroon   |                 |                 | [49]      |
| *P. acidus*  | India      | Harfarauri       | Fruit/leaves/roots | Jaundice, constipation, vomiting, biliousness, urinary concretions, piles, fever, smallpox, rheumatism, asthma, hepatic disease, diabetes, gonorrhea, ophthalmopathy, amnesia, psoriasis | [42, 43] |
|              | Thailand   | Otaheiti gooseberry, star gooseberry, mayom | Leaves/bark/root | Constipation, alcoholic addicts, hypertension, fever, dermatitis, menstruation fever | [44-46]  |
| *P. debilis* | India      | Bhuamiki         | Swelling, intestinal worms, fever, wound, inflammation, rheumatism | [34]      |
|              | Sri Lanka  | Bhuamiki         | Diabetes        | [47]      |
| *P. simplex*| India      | Bhuamveli, uchchiyusirika | Leaves/whole plant | Ophthalmopathy, gonorrhea, jaundice, mammary abscess, pruritus, diarrhoea, hepatitis, urinary infection | [48, 49] |
|              | China      | Huang zhuziao    | Leaves/whole plant | Ophthalmopathy, diarrhoea, hepatitis, urinary infection | [49]      |
| *P. discoides*| Cameroon   |                 |                 | [50]      |
| *P. fraternus*| India      | Bhuamiki         | Whole plant     | Constipation, jaundice, hepatic disorder, kidney disorders, bacterial infection | [29, 51, 52] |
|              | India      | Dyssentery, wound, fever, inflammation, snake bite, bacterial infection | [34]      |
| *P. hookeri* | India      | Dyssentery, wound, fever, inflammation, snake bite, bacterial infection | [34]      |
| *P. kozhikodianus*| India     | Dyssentery, jaundice, ulcer, itching, bacterial infection | [34]      |
| *P. maderaspatensis*| India   | Bhuamiki         | Whole plant     | Headache, constipation, diarrhoea, edematous, dysentery, fever, ulcer, burn, jaundice, bacterial infection, immunomodulatory | [34, 52] |
| *P. nozeranii*| India      | Bhuamiki         | Whole plant     | Headache, constipation, diarrhoea, edematous, dysentery, fever, ulcer, burn, jaundice, bacterial infection, immunomodulatory | [34, 52] |
| *P. orbicularis*| Cuba       | Bhuamiki         | Whole plant     | Headache, constipation, diarrhoea, edematous, dysentery, fever, ulcer, burn, jaundice, bacterial infection, immunomodulatory | [34, 52] |
| *P. piscatorum*| Venezuela | Aerial parts     | Wound, fungal infection | [53, 54] |
| *P. polyanthus*| Kenya      | Root             | Sexually transmitted diseases | [55]      |
| *P. polyphyllus*| India     | Sirunelli        | Leaves          | Liver disease                                                                     | [57]      |
| *P. rheedia* | India      | Whole plant      | Diabetes        | [58]      |
| *P. sellowianus*| South America | Sarandi blanco | Stems/leaves | Urination disorder, diabetes                                                      | [59]      |
| *P. taxodiifolius*| Thailand  | Leaves/twigs     | Urination disorder | Urination disorder                                                               | [60]      |
| *P. tenellus* | Brazil     | Erva pombinha, quebra-pedra | Leaves | Urination disorder, kidney calculi                                               | [61]      |
| *P. virgatus* | Thailand   | Look tai bai     | Gonorrhea, jaundice, diabetes, liver disease | [5]       |
Table 2: The compounds isolated from the genus *Phyllanthus* and part of pharmacological effects.

| Number | Compounds                                               | Species            | Pharmacological effects | References |
|--------|---------------------------------------------------------|--------------------|-------------------------|------------|
| 1      | (20S)-3α-Acetoxy-24-methylatedammaran-20-ol             | *P. polyanthus*    |                         | [56]       |
| 2      | (20S)-3β-Acetoxy-24-methylatedammaran-20-ol             | *P. polyanthus*    |                         | [56]       |
| 3      | Ocotillol-II                                            | *P. flexuosus*     |                         | [63]       |
| 4      | Phyllanthenol                                           | *P. niruri*        |                         | [64]       |
| 5      | Phyllanthenone                                          | *P. niruri*        |                         | [64]       |
| 6      | Phyllanthol                                             | *P. niruri*        |                         | [64]       |
| 7      | (+)-Songbodichapetalin                                  | *P. songboiensis*  |                         | [65]       |
| 8      | Acutissimatriterpene A                                  | *P. acutissima*    |                         | [66]       |
| 9      | Acutissimatriterpene B                                  | *P. acutissima*    |                         | [66]       |
| 10     | Acutissimatriterpene C                                  | *P. acutissima*    |                         | [66]       |
| 11     | Acutissimatriterpene D                                  | *P. acutissima*    |                         | [66]       |
| 12     | Acutissimatriterpene E                                  | *P. acutissima*    |                         | [66]       |
| 13     | Flexuosoids A                                           | *P. flexuosus*     |                         | [67]       |
| 14     | Flexuosoids B                                           | *P. flexuosus*     |                         | [67]       |
| 15     | δ-Amyrin acetate                                        | *P. polyanthus*    |                         | [56]       |
| 16     | 12(13)-Dehydro-3α-acetoxyolean-28-oic acid             | *P. pulcher*       |                         | [68]       |
| 17     | 3′-O-Acetyl-3-O-α-L-arabinosyl-23-hydroxyolean-12-en-28-oic acid | *P. polyphyllus* |                         | [69]       |
| 18     | 3α-Acetoxyl-25-hydroxyolean-12-en-28-oic acid          | *P. pulcher*       | Antitumor               | [68]       |
| 19     | 4′-O-Acetyl-3-O-α-L-arabinosyl-23-hydroxyolean-12-en-28-oic acid | *P. polyphyllus* |                         | [69]       |
| 20     | Olean-12-en-3β,15α,24-triol                             | *P. flexuosus*     | Antitumor               | [70, 71]   |
| 21     | Olean-12-en-3β,15α-diol                                 | *P. flexuosus*     | Antitumor               | [70, 71]   |
| 22     | Olean-12-en-3β,24-diol                                  | *P. fraternus*     |                         | [72]       |
| 23     | Olean-18-en-3α-ol                                      | *P. columnaris*    |                         | [76]       |
| 24     | Olea-11:13(18)-dien-3β-ol                               | *P. flexuosus*     |                         | [70]       |
| 25     | Olea-11:13(18)-dien-3β,24-diol                          | *P. flexuosus*     |                         | [70]       |
| 26     | Olea-9(11):12-dien-3β-ol                                | *P. flexuosus*     |                         | [70]       |
| 27     | Oleaenolic acid                                         | *P. urinaria*      |                         | [73]       |
| 28     | Phyllanosis                                             | *P. amarus*        |                         | [74]       |
| 29     | Phyllenolide A                                          | *P. myrtifolius*   |                         | [75]       |
| 30     | Phyllenolide B                                          | *P. myrtifolius*   |                         | [75]       |
| 31     | Phyllenolide C                                          | *P. myrtifolius*   |                         | [75]       |
| 32     | Taraxerol                                               | *P. columnaris*    |                         | [76]       |
| 33     | Taraxerone                                              | *P. reticulatus*   |                         | [77]       |
| 34     | Taraxerone                                              | *P. columnaris*    |                         | [76]       |
| 35     | Taraxeryl acetate                                       | *P. reticulatus*   |                         | [77]       |
| 36     | α-Amyrin                                                | *P. singampattiana*|                         | [78]       |
| 37     | β-Amyrin                                                | *P. urinaria*      |                         | [79]       |
| 38     | β-Amyrin                                                | *P. flexuosus*     |                         | [80]       |
| 39     | β-Amyrin                                                | *P. acidus*        |                         | [81]       |
| 40     | 11β-Hydroxy-D:A-friedolean-1-en-3-one                    | *P. flexuosus*     |                         | [82]       |
| 41     | 1β,22β-Dihydroxyfriedelin                              | *P. muellerianus*  |                         | [83]       |
| 42     | 2α-Hydroxyfriedelan-4(23)-en-3-one                      | *P. reticulatus*   |                         | [84]       |
| 43     | 2α-Hydroxyfriededlan-3-one                             | *P. reticulatus*   |                         | [84]       |
| 44     | 22β-Hydroxyfriedelan-1-one                             | *P. muellerianus*  |                         | [83]       |
| 45     | 26-Nor-D:A-friedolean-14-en-3-one                       | *P. watsonii*      |                         | [85]       |
| 46     | 26-Nor-D:A-friedolean-14-en-3β-ol                       | *P. watsonii*      |                         | [85]       |
| 47     | Friedelin                                               | *P. columnaris*    |                         | [86]       |
| Number | Compounds                | Species          | Pharmacological effects | References |
|--------|--------------------------|------------------|-------------------------|------------|
| 44     | 3,20-Dioxo-dinorfriedelane | *P. emblica*     |                         | [87]       |
| 45     | Epifriedelinol           | *P. reticulatus* |                         | [77]       |
| 45     | Epifriedelinol           | *P. singampattiana* |                      | [78]       |
| 46     | Friedelan-3β-ol          | *P. reticulatus* |                         | [84]       |
| 47     | Friedelin                | *P. niruri*      |                         | [88]       |
| 47     | Friedelin                | *P. reticulatus* |                         | [84]       |
| 47     | Friedelin                | *P. flexuosus*   |                         | [80]       |
| 47     | Friedelin                | *P. wightianus*  |                         | [89]       |
| 47     | Friedelin                | *P. singampattiana* |                      | [78]       |
| 48     | Polpunonic acid          | *P. oxyphyllus*  |                         | [90]       |
| 49     | Trichadenic acid B       | *P. flexuosus*   |                         | [91]       |
| 50     | 3-Friedelanone           | *P. muellerianus*|                         | [92]       |
| 51     | Betulin                  | *P. reticulatus* |                         | [77]       |
| 51     | Betulin                  | *P. flexuosus*   | Antitumor               | [70, 71]   |
| 52     | Betulinic acid           | *P. reticulatus* |                         | [84]       |
| 53     | Glochidiol               | *P. urinaria*    |                         | [73]       |
| 54     | Glochidiol               | *P. sellowianus* |                         | [93]       |
| 54     | Glochidone               | *P. virgatus*    |                         | [94]       |
| 54     | Glochidone               | *P. sellowianus* |                         | [95]       |
| 54     | Glochidone               | *P. watsonii*    |                         | [85]       |
| 54     | Glochidone               | *P. taxodifolius*| Antitumor               | [60, 96]   |
| 55     | Glochidone               | *P. pulcher*     | Antitumor               | [68]       |
| 55     | Glochidone               | *P. flexuosus*   |                         | [80]       |
| 55     | Glochidonol              | *P. reticulatus* |                         | [84]       |
| 55     | Glochidonol              | *P. sellowianus* |                         | [93]       |
| 55     | Glochidonol              | *P. watsonii*    |                         | [85]       |
| 55     | Glochidonol              | *P. pulcher*     | Antitumor               | [68]       |
| 56     | Lup-20(29)-en-3β,15α-diol| *P. flexuosus*   | Antitumor               | [63, 71]   |
| 57     | Lup-20(29)-en-3β,24-diol | *P. flexuosus*   | Antitumor               | [70, 71]   |
| 58     | Lup-20(29)-en-3β-ol      | *P. urinaria*    |                         | [97]       |
| 59     | Lup-20(29)-ene-3β,24-diol| *P. flexuosus*   |                         | [98]       |
| 60     | Lup-20(29)-ene-1β,3β-diol| *P. sellowianus* |                         | [93]       |
| 60     | Lup-20(29)-ene-1β,3β-diol| *P. watsonii*    |                         | [85]       |
| 61     | Lupanyl acetate          | *P. urinaria*    |                         | [99]       |
| 61     | Lupanyl acetate          | *P. watsonii*    |                         | [85]       |
| 61     | Lupanyl acetate          | *P. columnaris*  |                         | [86]       |
| 61     | Lupanyl acetate          | *P. pulcher*     |                         | [68]       |
| 62     | Lupenone                 | *P. polyanthus*  |                         | [56]       |
| 63     | Lupenyl palmitate        | *P. watsonii*    |                         | [85]       |
| 64     | Lupeol                   | *P. emblica*     |                         | [100]      |
| 64     | Lupeol                   | *P. urinaria*    |                         | [79]       |
| 64     | Lupeol                   | *P. reticulatus* |                         | [17]       |
| 64     | Lupeol                   | *P. flexuosus*   | Antitumor               | [71, 80]   |
| 64     | Lupeol                   | *P. oxyphyllus*  |                         | [90]       |
| 64     | Lupeol                   | *P. watsonii*    |                         | [85]       |
| 64     | Lupeol                   | *P. taxodifolius*| Antitumor               | [60, 96]   |
Table 2: Continued.

| Number | Compounds                                         | Species          | Pharmacological effects | References |
|--------|--------------------------------------------------|------------------|-------------------------|------------|
| 64     | Lupeol                                           | P. wightianus    |                         | [89]       |
| 64     | Lupeol                                           | P. columnaris    |                         | [86]       |
| 65     | Lupeol acetate                                   | P. reticulatus   |                         | [17]       |
| 66     | 29-Nor-3,4-seco-friedelan-(4Z,20(30))-dien-3-oic | P. oxyphyllus    |                         | [90]       |
| 67     | 3,7,11,15,19,23-Hexamethyl-2Z,6Z,10Z,14E,18E,22E-tetracosahexen-1-ol | P. niruri     |                         | [101]      |
| 68     | Phyllanthol                                      | P. sellowianus   |                         | [102]      |
| 68     | Phyllanthol                                      | P. polyanthus    |                         | [56]       |
| 68     | Phyllanthol                                      | P. acidus        |                         | [81]       |
| 69     | Phyllanthone                                     | P. polyanthus    |                         | [56]       |
| 70     | 4'-Hydroxypyllaemblicin B                        | P. emblica       |                         | [103]      |
| 71     | 5-Hydroxy-6,9-epoxyguaiane                       | P. oxyphyllus    |                         | [90]       |
| 72     | 5-O-Acetyl-6,9-epoxyguaiane                      | P. oxyphyllus    |                         | [90]       |
| 73     | Cloven-2β,9α-diol                                | P. urinaria      |                         | [73]       |
| 74     | Descinnamoylphyllanthocindiol                    | P. acuminatus    |                         | [104]      |
| 75     | Didesacetlyphyllanthostatin 3                   | P. acuminatus    |                         | [104]      |
| 76     | Dihydrophaseic acid-4'-O-β-D-glucopyranoside     | P. reticulatus   |                         | [105]      |
| 77     | Englerins A                                      | P. engleri       | Antitumor               | [106]      |
| 78     | Englerins B                                      | P. engleri       |                         | [106]      |
| 79     | Glochicoccin D                                   | P. emblica       |                         | [107]      |
| 80     | Jaslanicoside B                                  | P. cochinchinensis |                   | [108]      |
| 81     | Jasminoside                                      | P. cochinchinensis |                   | [108]      |
| 82     | Phyllaemblic acid                                | P. emblica       |                         | [109]      |
| 83     | Phyllaemblic acid B                              | P. emblica       |                         | [110]      |
| 84     | Phyllaemblic acid C                              | P. emblica       |                         | [110]      |
| 85     | Phyllaemblicin A                                 | P. emblica       |                         | [109]      |
| 86     | Phyllaemblicin B                                 | P. emblica       | Antiviral and antitumor | [109, 111, 112] |
| 87     | Phyllaemblicin C                                 | P. emblica       | Antitumor and antiviral | [109, 111, 113] |
| 88     | Phyllaemblicin D                                 | P. emblica       |                         | [110]      |
| 89     | Phyllaemblicin E                                 | P. emblica       |                         | [103]      |
| 90     | Phyllaemblicin F                                 | P. emblica       |                         | [103]      |
| 91     | Phyllaemblicin G1                                | P. emblica       |                         | [107]      |
| 92     | Phyllaemblicin G2                                | P. emblica       |                         | [107]      |
| 93     | Phyllaemblicin G3                                | P. emblica       |                         | [107]      |
| 94     | Phyllaemblicin G4                                | P. emblica       |                         | [107]      |
| 95     | Phyllaemblicin G5                                | P. emblica       |                         | [107]      |
| 96     | Phyllaemblicin G6                                | P. emblica       | Antiviral               | [107]      |
| 97     | Phyllaemblicin G7                                | P. emblica       |                         | [107]      |
| 98     | Phyllaemblicin G8                                | P. emblica       |                         | [107]      |
| 99     | Phyllaemblinol                                   | P. emblica       |                         | [114]      |
| 100    | Phyllanthocin                                    | P. brasiliensis  |                         | [115]      |
| 101    | Phyllanthoside                                   | P. acuminatus    | Antitumor               | [116]      |
| 101    | Phyllanthoside                                   | P. veuminatus    | Antitumor               | [117]      |
| 101    | Phyllanthoside                                   | P. brasiliensis  | Antitumor               | [115]      |
| 102    | Phyllanthostatin 1                               | P. acuminatus    | Antitumor               | [116]      |
| 102    | Phyllanthostatin 1                               | P. veuminatus    | Antitumor               | [117]      |
| 103    | Phyllanthostatin 2                               | P. acuminatus    | Antitumor               | [117]      |
| Number | Compounds | Species          | Pharmacological effects | References |
|--------|-----------|------------------|--------------------------|------------|
| 103    | Phyllanthostatin 2 | *P. veuminatus* | Antitumor | [117] |
| 104    | Phyllanthostatin 3 | *P. acuminatus* | Antitumor | [117] |
| 105    | Phyllanthostatin 6 | *P. veuminatus* | Antitumor | [117] |
| 106    | Phyllanthusol A | *P. acuminatus* | Antitumor | [46] |
| 107    | Phyllanthusol B | *P. acuminatus* | Antitumor | [46] |
| 108    | β-Caryophyllene | *P. emblica* | Antitumor | [113] |
| 109    | β-Bourbonene | *P. emblica* | Antitumor | [113] |
| 110    | 19-Hydroxyspruceanol 19-O-β-D-glucopyranoside | *P. reticulatus* | Antitumor | [118] |
| 111    | Cleistanthol | *P. urinaria* | Antitumor | [73] |
| 112    | Ent-3β-Hydroxykaur-16-ene | *P. flexuosus* | Antitumor | [80] |
| 113    | Orthosiphon G | *P. niruri* | Antitumor | [120] |
| 114    | Orthosiphon I | *P. niruri* | Antitumor | [120] |
| 115    | Phyllanflexoid A | *P. flexuosus* | Antitumor | [119] |
| 116    | Phyllanflexoid B | *P. flexuosus* | Antitumor | [119] |
| 117    | Phyllanflexoid C | *P. flexuosus* | Antitumor | [119] |
| 118    | Phyllanterpenyl ester | *P. fraternus* | Antitumor | [121] |
| 119    | Spruceanol | *P. urinaria* | Antitumor | [73] |
| 120    | Spruceanol | *P. reticulatus* | Antitumor | [13] |
| 121    | Spruceanol | *P. oxyphyllus* | Antitumor | [90] |
| 122    | Spruceanol | *P. songboiensis* | Antitumor | [65] |
| 123    | (3S,5R,6S,9R)-Megastigmane-3,9-diol 3-O-α-L-arabinofuranosyl-(1 → 6)-β-D-glucopyranoside | *P. reticulatus* | Antitumor | [13] |
| 124    | Turpenionoside A | *P. reticulatus* | Antitumor | [118] |
| 125    | Turpenionoside B | *P. reticulatus* | Antitumor | [118] |
| 126    | 7-O-[(2,3,4-Tri-O-acetyl)-α-L-arabinopyranosyl]diphyllin | *P. poilanei* | Antitumor | [123] |
| 127    | Arabelline | *P. songboiensis* | Antitumor | [67] |
| 128    | Acutissimalignans A | *P. songboiensis* | Antitumor | [65] |
| 129    | Acutissimalignans A | *P. acutissima* | Antitumor | [66] |
| 130    | Cleistanth A | *P. taxodiolius* | Antitumor | [96, 124] |
| 131    | Cleistanth A acetate | *P. taxodiolius* | Antitumor | [96, 124] |
| 132    | Cleistanth A Me ether | *P. taxodiolius* | Antitumor | [96, 124] |
| 133    | Cleistanth B | *P. poilanei* | Antitumor | [123] |
| 134    | Cleistanthoside A | *P. taxodiolius* | Antitumor | [96] |
| 135    | Cleistanthoside A tetraacetate | *P. taxodiolius* | Antitumor | [96, 124] |
| 136    | Dextroburseherin | *P. urinaria* | Anti-inflammatory | [125] |
| 137    | Diphyllin | *P. poilanei* | Anti-inflammatory | [123] |
|        | Diphyllin | *P. polyphyllus* | Anti-inflammatory | [126] |
| 138    | Hypophyllanthin | *P. niruri* | Hepatoprotection and hypotensive | [127–129] |
### Table 2: Continued.

| Number | Compounds          | Species          | Pharmacological effects                  | References         |
|--------|--------------------|------------------|------------------------------------------|--------------------|
| 137    | Hypophyllanthin    | *P. urinaria*    | Hypotensive                              | [125, 130]         |
| 137    | Hypophyllanthin    | *P. virgatus*    |                                          | [131]              |
| 137    | Hypophyllanthin    | *P. amarus*      | Antitumor and anti-CYP3A4                | [132–134]          |
| 137    | Hypophyllanthin    | *P. debilis*     |                                          |                    |
| 138    | Isolariciresinol   | *P. emblica*     |                                          | [144]              |
| 139    | Isolintetralin     | *P. niruri*      |                                          | [136]              |
| 139    | Isolintetralin     | *P. urinaria*    |                                          | [125]              |
| 140    | Justicidin A       | *P. myrtifolius* |                                          | [131]              |
| 141    | Justicidin B       | *P. myrtifolius* |                                          | [137]              |
| 141    | Justicidin B       | *P. polypyllus*  | Anti-inflammatory                        | [126]              |
| 141    | Justicidin B       | *P. anislobo*    |                                          | [138]              |
| 141    | Justicidin B       | *P. piscatorum*  | Antifungal, antitumor, and antiparasitic | [139]              |
| 142    | Lintetralin        | *P. niruri*      |                                          | [128]              |
| 142    | Lintetralin        | *P. urinaria*    |                                          | [125]              |
| 143    | (+)-Lyoniresinol   | *P. reticulatus* |                                          | [13]               |
| 144    | (+)-Lyoniresiol    | *P. urinaria*    |                                          | [73]               |
| 145    | Mananthoside I     | *P. reticulatus* |                                          | [118]              |
| 146    | Neonirtetralin     | *P. niruri*      |                                          | [140]              |
| 146    | Neonirtetralin     | *P. urinaria*    |                                          | [141]              |
| 147    | Nirtetralin        | *P. niruri*      | Antiviral and hypotensive                | [127, 128, 142]    |
| 147    | Nirtetralin        | *P. urinaria*    |                                          | [125]              |
| 147    | Nirtetralin        | *P. virgatus*    | Antiviral                                | [131, 143]         |
| 147    | Nirtetralin        | *P. amarus*      | Anti-inflammatory and antitumor          | [132, 144, 145]    |
| 148    | Nirtetralin A      | *P. niruri*      | Antiviral                                | [142]              |
| 149    | Nirtetralin B      | *P. niruri*      | Antiviral                                | [142, 146]         |
| 150    | Phyllamyricic A    | *P. myrtifolius* |                                          | [137]              |
| 151    | Phyllamyricic B    | *P. myrtifolius* |                                          | [137]              |
| 152    | Phyllamyricic C    | *P. myrtifolius* |                                          | [137]              |
| 152    | Phyllamyricic C    | *P. polyphyllus* | Anti-inflammatory                        | [126]              |
| 153    | Phyllamyricic D    | *P. myrtifolius* |                                          | [147]              |
| 154    | Phyllamyricic E    | *P. myrtifolius* |                                          | [147]              |
| 155    | Phyllamyricic F    | *P. myrtifolius* |                                          | [147]              |
| 156    | Phyllamyricic A    | *P. myrtifolius* | Anti-HIV                                 | [147]              |
| 157    | Phyllamyricic B    | *P. myrtifolius* |                                          | [147]              |
| 158    | Phyllamyricic C    | *P. myrtifolius* |                                          | [147]              |
| 159    | Phyllanthostatin A | *P. acuminatus*  |                                          | [148]              |
| 159    | Phyllanthostatin A | *P. anislobo*    |                                          | [138]              |
| 160    | Phyllanthusoside C | *P. cochinchnensis|                                          | [149]              |
| 161    | Phyllanthusmin A   | *P. poilanei*    |                                          | [123]              |
| 161    | Phyllanthusmin A   | *P. ologospermus*| Antitumor                                | [150]              |
| 162    | Phyllanthusmin B   | *P. reticulatus* |                                          | [13]               |
| Number | Compounds                        | Species               | Pharmacological effects                      | References  |
|--------|----------------------------------|-----------------------|----------------------------------------------|-------------|
| 162    | Phyllanthusmin B                 | *P. poilanei*         |                                              | [123]       |
| 162    | Phyllanthusmin B                 | *P. oligospermus*     |                                              | [150]       |
| 163    | Phyllanthusmin C                 | *P. reticulatus*      |                                              | [13]        |
| 163    | Phyllanthusmin C                 | *P. flexuosus*        |                                              | [67]        |
| 163    | Phyllanthusmin C                 | *P. poilanei*         | Anti-tumor                                   | [123]       |
| 163    | Phyllanthusmin C                 | *P. oligospermus*     |                                              | [150]       |
| 164    | Phyllanthusmin D                 | *P. poilanei*         |                                              | [123]       |
| 165    | Phyllanthusmin E                 | *P. poilanei*         |                                              | [123]       |
| 166    | Phyllanthusmin D'                | *P. flexuosus*        |                                              | [67]        |
| 167    | Phyllanthusmin E'                | *P. flexuosus*        |                                              | [67]        |
| 168    | Phyllanthusmin F                 | *P. flexuosus*        |                                              | [67]        |
| 169    | Phyltetralin                     | *P. urinaria*         | Anti-inflammatory                            | [128]       |
| 169    | Phyltetralin                     | *P. virgatus*         |                                              | [131]       |
| 169    | Phyltetralin                     | *P. amarus*           | Anti-inflammatory                            | [145]       |
| 170    | Piscatorin                       | *P. piscatorum*       | Antitumor                                    | [139]       |
| 172    | Reticulataside B                 | *P. reticulatus*      |                                              | [13]        |
| 173    | Retrojusticidin B                | *P. myrtifolius*      | Anti-HIV                                     | [137, 152]  |
| 174    | Seco-4-hydroxylinitetralin       | *P. niruri*           |                                              | [153]       |
| 175    | Taxodiifoloside                  | *P. taxodiifolius*    | Antitumor                                    | [124]       |
| 176    | Urinatetralin                    | *P. niruri*           |                                              | [154]       |
| 176    | Urinatetralin                    | *P. urinaria*         |                                              | [125]       |
| 177    | 2,3-Desmethoxy seco-isolitetalin | *P. niruri*           |                                              | [155]       |
| 178    | 2,3-Desmethoxy seco-isolitetalin diacetate | *P. niruri* |                                              | [155]       |
| 179    | 4-(3,4-Dimethoxy-phenyl)-1-(7-methoxy-benzo[1,3]dioxol-5-yl)-2,3-bismethoxymethyl-butan-1-ol | *P. amarus* |                                              | [132]       |
| 180    | 5-Demethoxy niranthin            | *P. urinaria*         |                                              | [125]       |
| 180    | 5-Demethoxy niranthin            | *P. amarus*           |                                              | [132]       |
| 181    | 7'-Hydroxy-3',4',5,9'-pentamethoxy-3,4-methylene dioxy lignan | *P. urinaria* | Antitumor                                    | [156]       |
| 182    | Demethylenedioxyviniranthin      | *P. niruri*           |                                              | [155]       |
| 183    | Dihydrocubebin                   | *P. niruri*           |                                              | [155]       |
| 183    | Dihydrocubebin                   | *P. urinaria*         |                                              | [73]        |
| 184    | Hydroxyniranthin                 | *P. niruri*           |                                              | [153]       |
| 185    | Linnanthin                       | *P. niruri*           |                                              | [155]       |
| 186    | Niranthin                        | *P. nigritus*         |                                              | [157]       |
| 186    | Niranthin                        | *P. urinaria*         |                                              | [125]       |
| 186    | Niranthin                        | *P. amarus*           | Anti-viral                                    | [131, 143]  |
| 186    | Niranthin                        | *P. amarus*           | Anti-inflammatory, antiparasitic, anti-hyperalgesic, antimicrobic | [132, 144, 158, 159] |
| 187    | Nirphyllin                       | *P. niruri*           |                                              | [160]       |
| 188    | Phyllanthin                      | *P. niruri*           | Hepatoprotective, hypotensive, and antihyperuricemic | [127, 157, 161, 162] |
| 188    | Phyllanthin                      | *P. urinaria*         | Immunomodulatory and hypotensive             | [125, 130, 163] |
| Number | Compounds                                                                 | Species       | Pharmacological effects                                      | References          |
|--------|---------------------------------------------------------------------------|---------------|-------------------------------------------------------------|---------------------|
| 188    | Phyllanthin                                                               | *P. amarus*   | Cell-protection, hepatoprotection, antitumor, and anti-CYP3A4 | [134, 144, 164, 165] |
| 188    | Phyllanthin                                                               | *P. fraternus*|                                                             | [72]                |
| 188    | Phyllanthin                                                               | *P. debilis*  |                                                             | [135]               |
| 189    | Seco-isolariciresinol                                                     | *P. oxyphyllus*|                                                             | [90]                |
| 190    | Seco-isolariciresinol trimethyl ether                                      | *P. niruri*   |                                                             | [153]               |
| 191    | (+)-8-(3,4-(Methylenedioxy)benzyl)-8′-(3′,4′-dimethoxybenzyl)-butyrolactone | *P. virgatus* |                                                             | [131]               |
| 192    | (+)-Secoisolariciresinol                                                 | *P. songboiensis* |                                                             | [65]                |
| 193    | (+)-Songbosin                                                             | *P. songboiensis* |                                                             | [65]                |
| 194    | 2S,3S-Bursehernin                                                        | *P. urinaria* |                                                             | [166]               |
| 195    | 3-(3,4-Dimethoxy-benzyl)-4-(7-methoxy-benzo[1,3]dioxol-5-ylmethyl)-dihydrofuran-2-one | *P. amarus*   |                                                             | [132]               |
| 196    | Acutissimalignans B                                                      | *P. acutissima* |                                                             | [66]                |
| 197    | Bursehernin                                                              | *P. amarus*   |                                                             | [132]               |
| 198    | Cubebin dimethyl ether                                                   | *P. niruri*   |                                                             | [154]               |
| 199    | Dibenzylbutyrolactone                                                    | *P. niruri*   |                                                             | [153]               |
| 200    | Heliobuphthalmin lactone                                                | *P. urinaria* |                                                             | [125]               |
| 200    | Heliobuphthalmin lactone                                                | *P. amarus*   |                                                             | [132]               |
| 201    | Hinokinin                                                                | *P. niruri*   |                                                             | [136]               |
| 201    | Hinokinin                                                                | *P. virgatus* | Antiviral                                                  | [131, 143]          |
| 202    | (7 R,7′R,8S,8′S)-Icariol A2                                              | *P. urinaria* |                                                             | [73]                |
| 203    | Phyllnirurin                                                             | *P. niruri*   |                                                             | [160]               |
| 204    | Urinaligran                                                              | *P. urinaria* |                                                             | [125]               |
| 205    | Virgatinus                                                               | *P. urinaria* |                                                             | [125]               |
| 205    | Virgatinus                                                               | *P. virgatus* |                                                             | [131]               |
| 205    | Virgatinus                                                               | *P. amarus*   |                                                             | [132]               |
| 206    | (+)-Diasyringaresinol                                                    | *P. flexuosus*|                                                             | [67]                |
| 207    | (−)-Episyringaresinol                                                   | *P. urinaria* |                                                             | [73]                |
| 207    | (−)-Episyringaresinol                                                   | *P. songboiensis* |                                                             | [65]                |
| 208    | (−)-Lirioresinol-B                                                      | *P. virgatus* |                                                             | [94]                |
| 209    | 4-Ketopinoresinol                                                       | *P. emblica*  |                                                             | [114]               |
| 210    | 4-Oxopinoresinol                                                        | *P. urinaria* |                                                             | [73]                |
| 211    | Lirioresinol A                                                          | *P. emblica*  |                                                             | [114]               |
| 212    | Medioresinol                                                            | *P. emblica*  |                                                             | [114]               |
| 213    | Pinoresinol                                                             | *P. oxyphyllus*|                                                             | [90]                |
| 213    | Pinoresinol                                                             | *P. songboiensis* |                                                             | [65]                |
| 214    | Syringaresinol                                                          | *P. emblica*  |                                                             | [114]               |
| 214    | Syringaresinol                                                          | *P. urinaria* |                                                             | [73]                |
| 214    | Syringaresinol                                                          | *P. reticulatus* |                                                             | [13]                |
| 215    | Virgatyne                                                               | *P. virgatus* |                                                             | [94]                |
| 216    | 4,9,9′-Trihydroxy-3,4′-dimethoxy-8-O-3′-neolignan                       | *P. emblcia*  |                                                             | [114]               |
| 217    | Caffeic acid                                                            | *P. urinaria* |                                                             | [167]               |
| 217    | Caffeic acid                                                            | *P. sellovianus* |                                                             | [168]               |
| 217    | Caffeic acid                                                            | *P. muellerianus* |                                                             | [169]               |
| Number | Compounds                          | Species          | Pharmacological effects | References  |
|--------|------------------------------------|------------------|-------------------------|-------------|
| 217    | Caffeic acid                       | *P. simplex*     |                         | [170]       |
| 218    | Cinnamic acid                      | *P. emblica*     | Antioxidant             | [171]       |
| 219    | Coniferyl aldehyde                 | *P. emblica*     |                         | [114]       |
| 220    | Evofolin B                         | *P. urinaria*    |                         | [73]        |
| 221    | Ferulic acid                       | *P. urinaria*    |                         | [172]       |
| 221    | Ferulic acid                       | *P. simplex*     |                         | [170]       |
| 222    | Methyl caffeate                    | *P. emblica*     |                         | [114]       |
| 223    | Phyllanthuosome A                  | *P. cochinichinensis* | Antitumor   | [149]       |
| 224    | Phyllanthuosome B                  | *P. cochinichinensis* |                | [149]       |
| 225    | Debelalactone                      | *P. debilis*     | Hepatoprotection        | [173]       |
| 226    | Isofraxidin                        | *P. sellowianus* |                         | [174]       |
| 227    | Scopeetin                          | *P. sellowianus* |                         | [174]       |
| 228    | 1,2,4,6-Tetra-O-galloyl-β-D-glucose | *P. emblica*  | Antiviral               | [175]       |
| 228    | 1,2,4,6-Tetra-O-galloyl-β-D-glucose | *P. niruri*   | Antiviral               | [176, 177] |
| 229    | 1,3,4,6-Tetra-O-galloyl-β-D-glucose | *P. virgatus* |                         | [94]        |
| 230    | 1,4,6-Tri-O-galloyl-β-D-glucose    | *P. virgatus*    |                         | [94]        |
| 231    | 1,6-Di-O-galloyl-β-D-glucose       | *P. virgatus*    |                         | [94]        |
| 232    | 1,2-Di-O-galloyl-3,6-(R)-hexa-hydroxydiphenoyl-β-D-glucose | *P. niruri* |                         | [176]       |
| 233    | Amarin                             | *P. amarus*      | Hepatoprotection, radioprotective, antioxidan | [178–181] |
| 234    | Amariinic acid                     | *P. amarus*      |                         | [182]       |
| 235    | Amarulone                          | *P. amarus*      |                         | [183]       |
| 236    | Carpinusnin                        | *P. emblica*     |                         | [184]       |
| 237    | Chebulagic acid                    | *P. emblica*     | Antioxidant and antitumor | [111, 184, 185] |
| 237    | Chebulagic acid                    | *P. myrtifolius* |                         | [186]       |
| 238    | Chebulanin                         | *P. emblica*     | Antioxidant             | [184, 185] |
| 239    | Corilagin                          | *P. niruri*      | Antihyperalgesic and anti-inflammatory | [6, 176, 188] |
| 239    | Corilagin                          | *P. urinaria*    | Antiviral and antiplatelet | [189–191] |
| 239    | Corilagin                          | *P. reticulatus* |                         | [192]       |
| 239    | Corilagin                          | *P. virgatus*    |                         | [94]        |
| 239    | Corilagin                          | *P. amarus*      | Antidiabetic, radioprotective, and anti-HIV | [179, 181, 193, 194] |
| 239    | Corilagin                          | *P. myrtifolius* |                         | [186]       |
| 239    | Corilagin                          | *P. muellerianus*|                         | [169]       |
| 239    | Corilagin                          | *P. debilis*     | Antioxidant             | [195]       |
| 239    | Corilagin                          | *P. matsumarai*  |                         | [196]       |
| 239    | Corilagin                          | *P. wightiana*   |                         | [89]        |
| 239    | Corilagin                          | *P. ussuriensis* | Antioxidant             | [197, 198] |
| 240    | Excoecarianin                      | *P. urinaria*    | Antiviral               | [199]       |
| 241    | Furosin                            | *P. emblica*     | Antioxidant             | [184, 187] |
| 241    | Furosin                            | *P. virgatus*    |                         | [94]        |
| 241    | Furosin                            | *P. sellowianus* | Antihyperalgesic        | [200]       |
| Number | Compounds     | Species           | Pharmacological effects                                      | References        |
|--------|---------------|-------------------|--------------------------------------------------------------|-------------------|
| 241    | Furosin       | *P. muellerianus*  | Wound healing                                                | [169]             |
| 241    | Furosin       | *P. debilis*      | Antioxidant                                                  | [195]             |
| 242    | Geraniin      | *P. emblica*      | Antioxidant and antitumor                                    | [111, 185, 201]   |
| 242    | Geraniin      | *P. niruri*       | Antiviral                                                    | [177]             |
| 242    | Geraniin      | *P. urinaria*     | Immunomodulatory, antioxidant, and hypertensive              | [41, 163]         |
| 242    | Geraniin      | *P. virgatus*     | Antiviral                                                    | [94, 143]         |
| 242    | Geraniin      | *P. amarus*       | Hepatoprotection, radioprotective, and anti-HIV              | [179–181, 194]    |
| 242    | Geraniin      | *P. myrtifolius*  | Antihyperalgesic                                            | [186]             |
| 242    | Geraniin      | *P. sellowianus*  | Wound healing and antimalarial                               | [169, 202]        |
| 242    | Geraniin      | *P. muellerianus* | Wound healing and antimalarial                               | [169, 202]        |
| 242    | Geraniin      | *P. debilis*      | Antioxidant                                                  | [195]             |
| 242    | Geraniin      | *P. matsumurai*   | Antitumor                                                    | [196]             |
| 242    | Geraniin      | *P. wightianus*   | Antitumor                                                    | [89]              |
| 242    | Geraniin      | *P. ussuriensis*  | Antitumor                                                    | [197]             |
| 242    | Geraniin      | *P. carolinensis* | Antitumor                                                    | [203]             |
| 243    | Geraniinic acid B | *P. amarus*     | Antiviral                                                    | [182]             |
| 244    | Hippomanin A  | *P. urinaria*     | Antiviral                                                    | [204]             |
| 245    | Isocorilagin  | *P. emblica*      | Antioxidant and antitumor                                    | [185, 201, 205]   |
| 245    | Isocorilagin  | *P. niruri*       | Cholinesterase inhibition                                    | [206, 207]        |
| 246    | Isomallotusin | *P. emblica*      | Antioxidant                                                  | [185]             |
| 247    | Isostrictinin | *P. emblica*      | Antioxidant                                                  | [208]             |
| 247    | Isostrictinin | *P. urinaria*     | Antioxidant                                                  | [209]             |
| 248    | Mallonin      | *P. emblica*      | Antitumor                                                    | [184]             |
| 249    | Mallotusin    | *P. emblica*      | Antitumor                                                    | [210]             |
| 249    | Mallotusin    | *P. myrtifolius*  | Antioxidant                                                  | [186]             |
| 250    | Neochebulagic acid | *P. emblica*   | Antioxidant                                                  | [184]             |
| 251    | Phyllanemblinin A | *P. emblica*    | Antioxidant                                                  | [184]             |
| 251    | Phyllanemblinin A | *P. flexuosus*  | Antioxidant                                                  | [211]             |
| 252    | Phyllanemblinin B | *P. emblica*    | Antitumor                                                    | [184]             |
| 252    | Phyllanemblinin B | *P. flexuosus*  | Antitumor                                                    | [211]             |
| 253    | Phyllanemblinin C | *P. emblica*    | Antitumor                                                    | [184]             |
| 253    | Phyllanemblinin C | *P. flexuosus*  | Antitumor                                                    | [211]             |
| 254    | Phyllanemblinin D | *P. emblica*    | Antitumor                                                    | [184]             |
| 254    | Phyllanemblinin D | *P. flexuosus*  | Antitumor                                                    | [211]             |
| 255    | Phyllanemblinin E | *P. emblica*    | Antitumor                                                    | [184]             |
| 255    | Phyllanemblinin E | *P. flexuosus*  | Antitumor                                                    | [211]             |
| 256    | Phyllanemblinin F | *P. emblica*    | Antitumor                                                    | [184]             |
| 257    | Phyllanthusin | *P. emblica*      | Antitumor                                                    | [212]             |
| 258    | PhyllanthusinC | *P. myrtifolius*  | Antioxidant                                                  | [186]             |
| 259    | PhyllanthusinD | *P. niruri*       | Antioxidant                                                  | [176]             |
| Number | Compounds | Species | Pharmacological effects | References |
|--------|-----------|---------|-------------------------|------------|
| 259    | Phyllanthusiin D | *P. amarus* | Radioprotective and antioxidant | [178, 181] |
| 260    | Phyllanthusiin G | *P. urinaria* | | [213] |
| 261    | Phyllanthusiin U | *P. urinaria* | | [167] |
| 262    | Pinocembrin-7-O-[3''-O-galloyl-4'',6''-(S)-hexahydroxydiphenoyl]-β-D-glucose | *P. tenellus* | | [214] |
| 263    | Pinocembrin-7-O-[4'',6''-(S)-hexahydroxydiphenoyl]-β-D-glucose | *P. tenellus* | | [214] |
| 264    | Punicafolin | *P. emblica* | | [184] |
| 265    | Putranjivain A | *P. emblica* | | [184] |
| 266    | Putranjivain B | *P. emblica* | | [185] |
| 267    | Repandusinic acid | *P. amarus* | Antioxidant | [178, 182] |
| 268    | Terchebin | *P. niruri* | | [176] |
| 269    | Tercatain | *P. emblica* | | [184] |
| 270    | Virganin | *P. virgatus* | | [94] |
| 271    | Dimeric procyanidins mono-gallates | *P. orbicularis* | Antiviral | [53] |
| 272    | Dimeric procyanidins-3,3'-di-O-gallates | *P. orbicularis* | Antiviral | [53] |
| 273    | Epicatechin-(4β → 8)-epigallocatechin | *P. emblica* | | [184] |
| 274    | Oligomeric procyanidins | *P. orbicularis* | Antiviral | [53] |
| 275    | Oligomeric procyanidins mono-gallates | *P. orbicularis* | Antiviral | [53] |
| 276    | Phylemtannin | *P. emblica* | Antitumor | [111] |
| 277    | Prodelphinidin B1 | *P. emblica* | | [184] |
| 277    | Prodelphinidin B1 | *P. niruri* | | [215] |
| 277    | Prodelphinidin B1 | *P. sellowianus* | | [216] |
| 277    | Prodelphinidin B1 | *P. orbicularis* | | [215] |
| 277    | Prodelphinidin B1 | *P. matsumurae* | | [217] |
| 278    | Prodelphinidin B2 | *P. emblica* | | [184] |
| 278    | Prodelphinidin B2 | *P. orbicularis* | Antioxidant | [53, 54] |
| 278    | Prodelphinidin B2 | *P. simplex* | | [170] |
| 278    | Prodelphinidin B2 | *P. matsumurae* | | [218] |
| 279    | Prodelphinidin B-2,3'-O-gallate | *P. emblica* | | [184] |
| 280    | 5,7-Dihydroxy-4'-methoxyflavonol | *P. virgatus* | | [94] |
| 281    | 5,3'-Dihydroxy-6,7,4'-trimethoxyflavone | *P. niruri* | | [207] |
| 282    | Astragalin | *P. urinaria* | | [141] |
| 282    | Astragalin | *P. virgatus* | | [94] |
| 282    | Astragalin | *P. muellerianus* | | [169] |
| 283    | Avicularin | *P. emblica* | | [219] |
| 284    | Galangin 3-O-β-D-glucoside 8-sulfonate | *P. virgatus* | | [94] |
| 285    | Isoquercitrin | *P. emblica* | | [201] |
| 285    | Isoquercitrin | *P. urinaria* | | [220] |
| 285    | Isoquercitrin | *P. reticulatus* | | [192] |
| 285    | Isoquercitrin | *P. virgatus* | | [94] |
| 285    | Isoquercitrin | *P. muellerianus* | | [169] |
| 286    | Kaempferol | *P. emblica* | Antioxidant | [201] |
| 286    | Kaempferol | *P. niruri* | | [79] |
| 286    | Kaempferol | *P. virgatus* | | [94] |
| 286    | Kaempferol | *P. cochinhusinensis* | | [149] |
| 287    | Kaempferol-3-O-α-L-(6''-ethyl)-rhamnopyranoside | *P. emblica* | | [221] |
| 288    | Kaempferol-3-O-α-L-(6''-methyl)-rhamnopyranoside | *P. emblica* | | [221] |
### Table 2: Continued.

| Number | Compounds                                                                 | Species          | Pharmacological effects | References |
|--------|---------------------------------------------------------------------------|------------------|-------------------------|------------|
| 289    | Kaempferol-3-O-β-D-glucopyranoside                                        | *P. emblica*     | Antioxidant             | [201]      |
| 290    | Kaempferol 8-sulfonate                                                    | *P. virgatus*    |                         | [94]       |
| 291    | Myricitrin                                                                | *P. virgatus*    |                         | [94]       |
| 292    | Quercetin                                                                 | *P. emblica*     | Antioxidant             | [171]      |
| 292    | Quercetin                                                                 | *P. urinaria*    |                         | [215]      |
| 292    | Quercetin                                                                 | *P. virgatus*    |                         | [94]       |
| 292    | Quercetin                                                                 | *P. caroliniensis* | Anti-inflammatory | [203]      |
| 293    | Quercetin 3-O-α-L-(2,4-di-O-acetyl) rhamnopyranoside                      | *P. urinaria*    |                         | [222]      |
| 294    | Quercetin 3-O-α-L-(3,4-di-O-acetyl) rhamnopyranoside                      | *P. urinaria*    |                         | [222]      |
| 295    | Quercetin 3-O-α-L-rhamnopyranoside                                        | *P. urinaria*    |                         | [222]      |
| 296    | Quercetin 3-O-β-D-glucopyranoside                                         | *P. emblica*     | Antioxidant             | [201]      |
| 297    | Quercetin 3-O-β-D-glucopyranosyl(1 → 4)-α-rhamnopyranoside                | *P. niruri*      |                         | [79]       |
| 298    | Quercetin 3-O-β-D-glucosyl-(1 → 6)-β-D-glucoside                          | *P. virgatus*    |                         | [94]       |
| 299    | Quercetin 3-O-β-D-glucopyranosyl-(2 → 1)-O-β-D-xylopyranoside              | *P. niruri*      |                         | [223]      |
| 300    | Quercetin pentaacetate                                                     | *P. orbicularis* |                         | [54]       |
| 301    | Quercitrin                                                                | *P. niruri*      | Antinociceptive         | [215, 224] |
| 301    | Quercitrin                                                                | *P. urinaria*    | Anti-inflammatory       | [151, 215] |
| 301    | Quercitrin                                                                | *P. virgatus*    |                         | [94]       |
| 301    | Quercitrin                                                                | *P. sellowianus* |                         | [95]       |
| 301    | Quercitrin                                                                | *P. muellerianus*|                         | [169]      |
| 301    | Quercitrin                                                                | *P. orbicularis* |                         | [54]       |
| 301    | Quercitrin                                                                | *P. ussuriensis* |                         | [225]      |
| 302    | Rhamnocitrin                                                              | *P. urinaria*    | Anti-inflammatory       | [151]      |
| 302    | Rhamnocitrin                                                              | *P. amarus*      |                         | [179]      |
| 302    | Rhamnocitrin                                                              | *P. cochinensis* |                         | [149]      |
| 302    | Rhamnocitrin                                                              | *P. simplex*     |                         | [170]      |
| 303    | Rutin                                                                     | *P. niruri*      | Anti-inflammatory       | [224]      |
| 303    | Rutin                                                                     | *P. urinaria*    | Anti-inflammatory       | [151, 215] |
| 303    | Rutin                                                                     | *P. reticulatus* |                         | [192]      |
| 303    | Rutin                                                                     | *P. virgatus*    |                         | [94]       |
| 303    | Rutin                                                                     | *P. amarus*      | Radioprotective and antioxidant | [178, 181] |
| 303    | Rutin                                                                     | *P. debilis*     | Antioxidant             | [195]      |
| 304    | Rutin decaacetate                                                         | *P. orbicularis* |                         | [54]       |
| 305    | Schaftoside                                                               | *P. cochinensis* |                         | [149]      |
| 306    | Sodium galangin-8-sulfonate                                               | *P. virgatus*    |                         | [94]       |
| 307    | Sodium galangin-3-O-β-glucoside-8-sulfonate                               | *P. virgatus*    |                         | [94]       |
| 308    | Sodium kaempferol-8-sulfonate                                             | *P. virgatus*    |                         | [94]       |
| 309    | Vicenin-2                                                                 | *P. cochinensis* |                         | [149]      |
| 310    | 4'-Methoxyscutellarein                                                    | *P. urinaria*    |                         | [226]      |
| 311    | Apigenin                                                                  | *P. amarus*      |                         | [74]       |
| 311    | Apigenin                                                                  | *P. orbicularis* | Antioxidant             | [54]       |
| 312    | Apigenin-7-O-(6''-butyryl-β-glucopyranoside)                              | *P. emblica*     |                         | [227]      |
| 312    | Apigenin-7-O-(6''-butyryl-β-glucopyranoside)                              | *P. niruri*      |                         | [215]      |
| 312    | Apigenin-7-O-(6''-butyryl-β-glucopyranoside)                              | *P. urinaria*    |                         | [215]      |
| 313    | Demethoxysudachitin (4',5,7-trihydroxy-6,8-dimethoxyflavone)              | *P. atropurpureus* |                     | [228]      |
| Number | Compounds | Species | Pharmacological effects | References |
|--------|-----------|---------|-------------------------|------------|
| 314    | Galangin 8-sulfonate | *P. virgatus* | | [94] |
| 315    | Luteolin | *P. amarus* | | [74] |
| 315    | Luteolin | *P. singampattiana* | | [78] |
| 316    | Niruriflavone | *P. niruri* | Antioxidant | [206] |
| 317    | Urinariaflavone | *P. urinaria* | | [141] |
| 318    | 2-(4-Hydroxyphenyl)-8-(3-methylbut-2-enyl)-chroman-4-one | *P. sellowianus* | | [23] |
| 319    | 7-Hydroxyflavanone | *P. niruri* | Antiparasitic | [23] |
| 320    | 8-(3-Methyl-but-2-enyl)-2-phenyl chroman-4-one | *P. niruri* | | [229] |
| 321    | Nirurin | *P. niruri* | | [229] |
| 322    | Nirurinetin | *P. niruri* | | [229] |
| 323    | (S)-Eriodictyol 7-O-(6‴-O-(E)-β-coumaroyl)-β-D-glucopyranoside | *P. emblica* | | [230] |
| 324    | (S)-Eriodictyol 7-O-(6‴-O-galloyl)-β-D-glucopyranoside | *P. emblica* | | [230] |
| 325    | (+)-Catechin | *P. orbicularis* | | [53] |
| 325    | (+)-Catechin | *P. niruri* | | [176] |
| 326    | (-)-Epiafzelechin | *P. emblica* | | [184] |
| 327    | (-)-Epicatechin | *P. emblica* | | [184] |
| 327    | (-)-Epicatechin | *P. niruri* | | [176] |
| 327    | (-)-Epicatechin | *P. cochinichinesis* | | [149] |
| 328    | (-)-Epicatechin | *P. orbicularis* | | [53] |
| 329    | (−)-Epigallocatechin | *P. emblica* | | [184] |
| 328    | (−)-Epigallocatechin | *P. niruri* | | [176] |
| 328    | (−)-Epigallocatechin | *P. reticulatus* | | [118] |
| 329    | (−)-Epigallocatechin | *P. emblica* | | [184] |
| 329    | (−)-Epigallocatechin | *P. niruri* | | [176] |
| 330    | 8-(2-Pyrrolidinone-5-yl)-(−)-epicatechin | *P. cochinichinesis* | | [149] |
| 331    | 5,7-Dimethoxy-3,4‴-dihydroxy-3′,8-di-C-prenylflavanone | *P. niruri* | | [231] |
| 332    | 5,6,8,4‴-Tetrahydroxy isoflavone | *P. atropurpureus* | | [228] |
| 333    | 6-Hydroxy-7,8,2′,3′,4‴-pentamethoxyisoflavone | *P. niruri* | | [207] |
| 334    | (−)-β-Sitosterol-3-O-β-D-(6-O-palmitoyl) glucopyranoside | *P. songboiensis* | | [65] |
| 335    | (3β,22E)-Stigmasta-5,22-diene-3,25-diol | *P. urinaria* | | [73] |
| 336    | 24-Isopropylcholesterol | *P. niruri* | | [157] |
| 337    | 5α,6β-Dihydroxy sitosterol | *P. emblica* | | [232] |
| 338    | 5α,6β,7α-Trihydroxy sitosterol | *P. emblica* | | [232] |
| 339    | 6‴-(Stigmast-5-en-3-O-β-D-glucopyranosidyl) hexadecanoate | *P. emblica* | | [232] |
| 340    | 6‴-(Stigmast-5-en-7-one-3-O-β-D-glucopyranosidyl) hexadecanoate | *P. emblica* | | [232] |
| 341    | 7-Ketositosterol | *P. emblica* | | [232] |
| 342    | 7α-Hydroxysitosterol | *P. emblica* | | [232] |
| 343    | 7α-Acetoxy sitosterol | *P. emblica* | | [232] |
| 344    | 7β-Ethoxysiterol | *P. emblica* | | [232] |
| 345    | Amarosterol A | *P. amarus* | | [233] |
| 346    | Amarosterol B | *P. amarus* | | [233] |
| 347    | Campesterol | *P. sellowianus* | | [216] |
| 348    | Daucosterol | *P. emblica* | | [232] |
| 348    | Daucosterol | *P. urinaria* | | [220] |
| 348    | Daucosterol | *P. amarus* | | [74] |
| 349    | Fraternusterol | *P. fraternus* | | [234] |
| Number | Compounds                                      | Species         | Pharmacological effects | References |
|--------|-----------------------------------------------|-----------------|--------------------------|------------|
| 350    | Phyllanthosecosteryl ester                   | *P. fraternus*  |                          | [234]      |
| 351    | Phyllanthosterol                              | *P. fraternus*  |                          | [234]      |
| 352    | Phyllanthostigmasterol                        | *P. fraternus*  |                          | [234]      |
| 353    | Stigmaster-4-en-3-one                          | *P. emblica*    |                          | [232]      |
| 354    | Stigmaster-4-en-3,6-dione                     | *P. emblica*    |                          | [232]      |
| 355    | Stigmaster-4-en-6β-ol-3-one                   | *P. emblica*    |                          | [232]      |
| 356    | Stigmaster-4-ene-3β,6α-diol                   | *P. emblica*    |                          | [232]      |
| 357    | Stigmaster-4,5-en-3-one                       | *P. oxyphyllus* |                          | [90]       |
| 358    | Stigmaster-5-en-3-ol, oleate                  | *P. amarus*     |                          | [74]       |
| 359    | Stigmasterol                                  | *P. urinaria*   |                          | [97]       |
| 360    | Stigmasterol 3-O-β-D-glucoside                | *P. amarus*     |                          | [100]      |
|        | β-Daucosterol                                 | *P. emblica*    | Antioxidant              | [171, 212] |
| 361    | β-Sitosterol                                   | *P. emblica*    |                          | [100]      |
| 362    | β-Sitosterol                                   | *P. niruri*     |                          | [157]      |
| 363    | β-Sitosterol                                   | *P. urinaria*   |                          | [220]      |
| 364    | β-Sitosterol                                   | *P. reticulatus*|                          | [77]       |
| 365    | β-Sitosterol                                   | *P. sellowianus*|                          | [216]      |
| 366    | β-Sitosterol                                   | *P. muellerianus|                          | [92]       |
| 367    | β-Sitosterol                                   | *P. oxyphyllus* |                          | [90]       |
| 368    | β-Sitosterol                                   | *P. fraternus*  |                          | [72]       |
| 369    | β-Sitosterol                                   | *P. debilis*    |                          | [135]      |
| 370    | β-Sitosterol                                   | *P. singampattiana* |            | [78]       |
| 371    | β-Sitosterol-3-O-β-D-glucopyranoside           | *P. urinaria*   |                          | [151]      |
| 372    | 14,15-Dihydroallosecurinin-15β-ol             | *P. discoideus* |                          | [148]      |
| 373    | 4-Hydroxysecurinine                           | *P. niruri*     |                          | [235]      |
| 374    | 4-Methoxydihydronecurinin                     | *P. niruri*     |                          | [235]      |
| 375    | β-Sitosterol-3-β-D-glucopyranoside            | *P. singampattiana* |                | [78]       |
| 376    | 4-Methoxynorsecurinine                        | *P. niruri*     |                          | [236]      |
| 377    | 4-Methoxymethyhydrosecurinin                  | *P. niruri*     |                          | [235]      |
| 378    | Allosecurinine                                | *P. niruri*     |                          | [235]      |
| 379    | Allosecurinine                                | *P. glaucus*    |                          | [237]      |
| 380    | Dihydrosecurinine                             | *P. niruri*     |                          | [235]      |
| 381    | Ent-norsecurinine                             | *P. niruri*     |                          | [238]      |
| 382    | Epibubbialine                                  | *P. niruri*     |                          | [239]      |
| 383    | Epibubbialine                                  | *P. amarus*     |                          | [240]      |
| 384    | Isobubbialine                                  | *P. niruri*     |                          | [215]      |
| 385    | Isobubbialine                                  | *P. urinaria*   |                          | [215]      |
| 386    | Isobubbialine                                  | *P. amarus*     |                          | [240]      |
| 387    | Methyl(2S)-1-[2-(furan-2-yl)-2-oxoethyl]-5-oxoppyrrolidine-2-carboxylate | *P. emblica* |                          | [114]      |
| 388    | Nirurine                                       | *P. niruri*     |                          | [241]      |
| 389    | Niruroidine                                    | *P. niruroides* |                          | [242]      |
| 390    | Nitidine                                       | *P. sellowianus*|                          | [243]      |
| 391    | Norsecurinine                                  | *P. niruri*     |                          | [235]      |
### Table 2: Continued.

| Number | Compounds | Species | Pharmacological effects | References |
|--------|-----------|---------|-------------------------|------------|
| 379    | Norsecurinine | *P. amarus* | Antifungal | [240, 244] |
| 379    | Norsecurinine | *P. simplex* | | [245] |
| 379    | Norsecurinine | *P. discoides* | | [246] |
| 380    | Phyllanthine | *P. niruri* | | [236] |
| 380    | Phyllanthine | *P. amarus* | | [240] |
| 381    | Securinine | *P. niruri* | | [235] |
| 381    | Securinine | *P. amarus* | | [240] |
| 381    | Securinine | *P. glaucus* | | [237] |
| 382    | Securinol A | *P. niruri* | | [235] |
| 382    | Securinol B | *P. niruri* | | [235] |
| 384    | Simplexine | *P. simplex* | | [245] |
| 385    | Virosecurinine | *P. niruri* | | [235] |
| 386    | Virosecurinine | *P. discoides* | | [247] |
| 387    | 1,12-Diazacyclodocosane-2,11-dione | *P. niruri* | | [248] |
| 388    | 3-(3-Methylbut-2-en-1-yl) isoguanine | *P. reticulatus* | | [118] |
| 389    | 5-Hydroxy-isouquinoline | *P. emblica* | Antimalarial | [250] |
| 390    | E,E-2,4-Octadienamide | *P. fraternus* | | [250] |
| 391    | E,Z-2,4-Decadienamide | *P. fraternus* | Antimalarial | [250] |
| 392    | Indole-3-carboxaldehyde | *P. virgatus* | | [94] |
| 393    | Indole-3-carboxylic acid | *P. virgatus* | | [131] |
| 394    | Phyllanthimide | *P. sellowianus* | | [251] |
| 395    | Phyllurine | *P. urinaria* | | [252] |
| 396    | (−)-Epicatechin 3-O-gallate | *P. orbicularis* | Antiviral | [53] |
| 397    | (−)-Epicatechin 3-O-gallate | *P. emblica* | | [111] |
| 398    | (−)-Epigallocatechin 3-O-gallate | *P. niruri* | | [176] |
| 399    | (−)-Epigallocatechin 3-O-gallate | *P. reticulatus* | | [16] |
| 400    | 1-O-Galloyl-6-O-luteoyl-α-D-glucose | *P. niruri* | Antimalarial | [223] |
| 401    | 2-(2-Methylbutryl)phloroglucinol | *P. emblica* | Antidiabetic and antitumor | [110, 253, 254] |
| 402    | 1-O-(6‴-O-β-D-apiofuranosyl)-β-D-glucopyranoside | *P. emblica* | | [110] |
| 403    | 2,3,5,6-Tetrahydroxylbenzyl acetate | *P. emblica* | | [110] |
| 404    | 2,6-Dimethoxy-4-(2-hydroxyethyl)phenol 1-O-β-D-glucopyranoside | *P. emblica* | | [110] |
| 405    | 3‴-Hydroxy robustaside A (6‴-(3‴,4‴,5‴-trihydroxy cinnamoyl) arbutin) | *P. atropurpureus* | | [228] |
| 406    | 3‴-Di-O-methylellagic acid | *P. reticulatus* | | [105] |
| 407    | 3‴,3‴-Tri-O-methylellagic acid | *P. urinaria* | | [172] |
| 408    | 3‴,3‴-Tri-O-methylellagic acid | *P. virgatus* | | [16] |
| 409    | 3‴,4‴,9‴,10‴-Pentahydroxy-dibenzo[b,d] pyran-6-one | *P. emblica* | | [114] |
| 410    | 3‴,6-di-O-Methylellagic acid | *P. reticulatus* | | [105] |
| 411    | 3,5-Dicaffeoylquinic acid | *P. muellerianus* | | [169] |
| 412    | 3,5-Dihydroxy-4-methoxybenzoic acid | *P. urinaria* | | [73] |
| Number | Compounds                                      | Species        | Pharmacological effects          | References |
|--------|-----------------------------------------------|----------------|----------------------------------|------------|
| 413    | 3-Ethylgallic acid                             | *P. emblica*   |                                  | [208]      |
| 414    | 3-O-Methylellagic acid 4′-O-α-L-rhamnopyranoside | *P. reticulatus* |                                  | [105]      |
| 415    | 4,4′-Di-O-methylellagic acid                   | *P. reticulatus* |                                  | [105]      |
| 416    | 4-Hydroxy-3-methoxybenzaldehyde                | *P. emblica*   |                                  | [114]      |
| 417    | 4-Hydroxy-3-methoxy-benzoic acid              | *P. amarus*    |                                  | [74]       |
| 418    | 4-O-Caffeoylquinic acid                        | *P. niruri*    |                                  | [257]      |
| 419    | 4-O-Methylellagic acid-3′-α-rhamnoside         | *P. emblica*   |                                  | [87]       |
| 420    | 4-O-Methylgallic acid                          | *P. polyphyllus* | Anti-inflammatory                 | [126]      |
| 421    | 8,9-Epoxy brevifolin                           | *P. simplex*   | Hepatoprotective                 | [258]      |
| 422    | Bergenin                                       | *P. flexuosus*  |                                  | [80]       |
| 423    | Bergenin                                       | *P. wightianus* |                                  | [89]       |
| 424    | Brevifolin                                     | *P. urinaria*  |                                  | [259]      |
| 425    | Brevifolin                                     | *P. virgatus*  |                                  | [94]       |
| 426    | Dehydrochebulic acid trimethyl ether           | *P. simplex*   | Hepatoprotective                 | [260]      |
| 427    | Brevifolin carboxylic acid                     | *P. niruri*    |                                  | [261]      |
| 428    | Brevifolin carboxylic acid                     | *P. urinaria*  |                                  | [209]      |
| 429    | Brevifolin carboxylic acid                     | *P. amarus*    | Antidiabetic                     | [193]      |
| 430    | Dehydrochebulic acid trimethyl ether           | *P. matsumurae* |                                  | [196]      |
| 431    | Ellagic acid                                   | *P. emblica*   | Antioxidant                      | [100, 210]  |
| 432    | Ellagic acid                                   | *P. niruri*    | Antidiabetic                     | [202, 261]  |
| 433    | Ellagic acid                                   | *P. urinaria*  | Antitumor                        | [220, 262]  |
| 434    | Ellagic acid                                   | *P. reticulatus* |                                  | [192]      |
| 435    | Ellagic acid                                   | *P. matsumurae* |                                  | [196]      |
| 436    | Ethyl brevifolin carboxylate                   | *P. niruri*    |                                  | [261]      |
| 437    | Ethyl brevifolin carboxylate                   | *P. urinaria*  |                                  | [189]      |
| 438    | Ethyl gallate                                  | *P. emblica*   | Antitussive                      | [212, 263]  |
| 439    | Ethyl gallate                                  | *P. myrtifolius* |                                  | [186]      |
| 440    | Flavogallonic acid bislactone                  | *P. emblica*   |                                  | [184]      |
| 441    | Gallic acid                                    | *P. emblica*   | Antiulcer and antioxidant        | [210, 264]  |
| 442    | Gallic acid                                    | *P. niruri*    | Anti-inflammatory                | [202, 224]  |
| 443    | Gallic acid                                    | *P. urinaria*  |                                  | [220]      |
| 444    | Gallic acid                                    | *P. virgatus*  |                                  | [94]       |
| 445    | Gallic acid                                    | *P. amarus*    | Antijaundice                     | [265]      |
| 446    | Gallic acid                                    | *P. myrtifolius* |                                  | [186]      |
| 447    | Gallic acid                                    | *P. muellerianus* |                              | [169]      |
| 448    | Gallic acid                                    | *P. debilis*   | Antioxidant                      | [195]      |
| 449    | Gallic acid                                    | *P. simplex*   |                                  | [170]      |
| 450    | Gallic acid                                    | *P. matsumurae* |                                  | [196]      |
| Number | Compounds                                      | Species          | Pharmacological effects | References |
|--------|-----------------------------------------------|------------------|-------------------------|------------|
| 434    | Gallic acid                                   | *P. wightianus*   |                         | [89]       |
| 434    | Gallic acid                                   | *P. ussuriensis* |                         | [225]      |
| 435    | Gallic acid 3-O-(6'-O-galloyl)-β-D-glucoside | *P. emblica*     |                         | [184]      |
| 436    | Gallic acid 3-O-β-D-glucoside                 | *P. emblica*     |                         | [184]      |
| 437    | Gallic acid 4-methyl ether                    | *P. cochinensis* | Antihyperalgesic        | [266]      |
| 438    | Gallic acid ethyl ester                      | *P. urinaria*    |                         | [95]       |
| 438    | Gallic acid ethyl ester                      | *P. sellowianus* |                         |            |
| 438    | Gallic acid ethyl ester                      | *P. carolinensis*| Anti-inflammatory        | [203]      |
| 439    | Koaburaside                                   |                  |                         | [149]      |
| 440    | L-Malic acid 2-O-gallate                     | *P. emblica*     | Antitumor               | [111, 253] |
| 440    | Methyl-4-hydroxybenzoate                      | *P. emblica*     |                         | [114]      |
| 442    | Methyl brevifolin carboxylate                 | *P. niruri*      | Hypotensive and antiplatelet | [206, 267, 268] |
| 442    | Methyl brevifolin carboxylate                 | *P. urinaria*    | Antioxidant and anti-inflammatory | [151, 269] |
| 442    | Methyl brevifolin carboxylate                 | *P. reticulatus* |                         | [192]      |
| 442    | Methyl brevifolin carboxylate                 | *P. virgatus*    |                         | [94]       |
| 442    | Methyl ester dehydrochebulic acid            | *P. urinaria*    |                         | [269]      |
| 442    | Methyl gallate                               | *P. emblica*     | Antioxidant and antitussive | [187, 263] |
| 444    | Methyl gallate                               | *P. urinaria*    | Antioxidant and anti-inflammatory | [151]      |
| 444    | Methyl gallate                               | *P. reticulatus* |                         | [192]      |
| 444    | Methyl gallate                               | *P. virgatus*    |                         | [94]       |
| 444    | Methyl gallate                               | *P. myrtifolius* |                         | [186]      |
| 444    | Methyl gallate                               | *P. muellerianus*|                         | [169]      |
| 444    | Methyl gallate                               | *P. ussuriensis* |                         | [197]      |
| 445    | Mucic acid 1,4-lactone 2-O-gallate           | *P. emblica*     |                         | [253]      |
| 446    | Mucic acid 1,4-lactone 3,5-di-O-gallate       | *P. emblica*     |                         | [253]      |
| 447    | Mucic acid 1,4-lactone 3-O-gallate           | *P. emblica*     | Antioxidant             | [185, 253] |
| 448    | Mucic acid 1,4-lactone 5-O-gallate           | *P. emblica*     |                         | [253]      |
| 449    | Mucic acid 1,4-lactone 6-methyl ester 2-O-gallate | *P. emblica* |                         | [253]      |
| 450    | Mucic acid 1,4-lactone 6-methyl ester 5-O-gallate | *P. emblica* |                         | [253]      |
| 451    | Mucic acid 1-methyl ester 2-O-gallate        | *P. emblica*     |                         | [253]      |
| 452    | Mucic acid 2-O-gallate                        | *P. emblica*     | Antitumor               | [111, 253] |
| 453    | Mucic acid 3-O-gallate                       | *P. emblica*     |                         | [270]      |
| 454    | Mucic acid 6-methyl ester 2-O-gallate        | *P. emblica*     |                         | [253]      |
| 455    | Mucic acid di-methyl ester 2-O-gallate       | *P. emblica*     |                         | [253]      |
| 456    | p-Hydroxybenzaldehyde                        | *P. urinaria*    |                         | [73]       |
| 457    | Phloroglucin                                  | *P. ussuriensis* |                         | [225]      |
| 458    | Phyllangin                                    | *P. niruri*      |                         | [256]      |
| 459    | Phyllanthusin F                              | *P. urinaria*    |                         | [271]      |
| 460    | Potassium brevifolin carboxylate             | *P. virgatus*    |                         | [94]       |
| 461    | Protocatechuic acid                           | *P. urinaria*    |                         | [189]      |
| 461    | Protocatechuic acid                           | *P. matsumurae*  |                         | [196]      |
| 462    | Pyrogallol                                    | *P. emblica*     | Antitumor and anti-inflammatory | [249, 272] |
| 462    | Pyrogallol                                    | *P. urinaria*    |                         | [167]      |
| Number | Compounds                                                                 | Species            | Pharmacological effects                      | References |
|--------|---------------------------------------------------------------------------|--------------------|-----------------------------------------------|------------|
| 463    | Robustaside A                                                             | *P. atropurpureus* | Antitumor                                     | [228]      |
| 464    | Shikimic acid                                                             | *P. myrtifolius*   |                                               |            |
| 465    | Syringaldehyde                                                            | *P. emblica*       |                                               |            |
| 466    | Tri-Me dehydrochebulic acid                                               | *P. urinaria*      |                                               |            |
| 467    | Trimethyl-3,4-dehydrocetate                                                | *P. urinaria*      | Antioxidant and anti-inflammatory              | [151]      |
| 468    | Vanillic acid                                                             | *P. emblica*       |                                               | [114]      |
| 469    | (-)-7'-Hydroxydivanillyltetrahydrofuran                                   | *P. songboiensis*  |                                               | [65]       |
| 470    | (+)-Cucurbitic acid                                                       | *P. urinaria*      |                                               | [73]       |
| 471    | (+)-Methyl cucurbate                                                      | *P. urinaria*      |                                               | [73]       |
| 472    | (E)-3-(5'-Hydroxy-2,2'-dihydroxy[1,1'-biphenyl]-4-yl)-2-propenoic acid    | *P. urinaria*      |                                               | [255]      |
| 473    | 1'S-11-Dehydroxy penicillide                                              | *P. emblica*       |                                               | [114]      |
| 474    | 2R-Diethyl malate                                                         | *P. emblica*       |                                               | [114]      |
| 475    | 3,6'-Di-O-benzoyl-2'-O-acetylsucrose                                       | *P. cochinensis*   |                                               | [108]      |
| 476    | 3,6'-Di-O-benzoyl-3'-O-acetylsucrose                                       | *P. cochinensis*   |                                               | [108]      |
| 477    | 3,6'-Di-O-benzoyl-4'-O-acetylsucrose                                       | *P. cochinensis*   |                                               | [108]      |
| 478    | 3,6'-Di-O-benzoysucrose                                                  | *P. cochinensis*   |                                               | [108]      |
| 479    | 3,4-Dimethoxysphenyl-β-D-glucopyranoside                                  | *P. cochinensis*   |                                               | [149]      |
| 480    | 3,4-Dihydroxyphenylpropanol 3-O-β-D-glucopyranoside                       | *P. reticulatus*   |                                               | [118]      |
| 481    | 3,4,5-Trimethoxy-phenyl-β-D-glucopyranoside                              | *P. cochinensis*   |                                               | [149]      |
| 482    | 3-O-Benzoyl-6'-O-(E)-cinnamoylsucrose                                     | *P. cochinensis*   |                                               | [108]      |
| 483    | 4,4,8-Trimethoxy chroman                                                  | *P. amarus*        |                                               | [273]      |
| 484    | 5-Hydroxymethyl-2-furaldehyde                                             | *P. urinaria*      |                                               | [73]       |
| 485    | 4-Hydroxyesamin                                                           | *P. niruri*        |                                               | [274]      |
| 486    | 5-Hydroxymethylfurfural                                                  | *P. emblica*       | Antioxidant                                   | [171]      |
| 487    | Aquilegiolide                                                             | *P. anisolobus*    |                                               | [138]      |
| 488    | Aquilegiolide                                                             | *P. klotzschianus* |                                               | [275]      |
| 489    | Bis(2-ethylcosyl)phthalate                                               | *P. muellerianus*  |                                               | [92]       |
| 490    | Bis(2-ethylclocyl)phthalate                                              | *P. muellerianus*  |                                               | [92]       |
| 491    | Dio-methylcrenatin                                                        | *P. cochinensis*   |                                               | [149]      |
| 492    | Byzantionoside B                                                         | *P. multiflorus*    |                                               | [276]      |
| 493    | Carthamoside B                                                           | *P. reticulatus*   |                                               | [118]      |
| 494    | Dendranthemoside B                                                       | *P. urinaria*      |                                               | [141]      |
| 495    | Hovetrichoside A                                                         | *P. reticulatus*   |                                               | [118]      |
| 496    | Isotachioside                                                            | *P. reticulatus*   |                                               | [118]      |
| 497    | Menisdaurilide                                                           | *P. anisolobus*    |                                               | [138]      |
| 498    | Methyl (1-[R,2R,Z]-2-(5'-hydroxy-pent-2'-enyl)-3-oxocyclopentaneacetate) | *P. urinaria*      |                                               | [73]       |
| 499    | Mucic acid                                                               | *P. emblica*       |                                               | [277]      |
| 500    | Mucic acid 1-methyl ester-6-ethyl ester                                  | *P. emblica*       |                                               | [114]      |
| 501    | Penicillide                                                               | *P. emblica*       |                                               | [114]      |
| 502    | Phthalic acid bis(2,5-dimethylhexyl) ester                                | *P. urinaria*      |                                               | [99]       |
| 503    | Phyllanthoid A                                                           | *P. cochinensis*   | Antitumor                                     | [278]      |
| 504    | Phyllanthoid B                                                           | *P. cochinensis*   |                                               | [278]      |
| 505    | Phyllanthusone                                                            | *P. urinaria*      |                                               | [279]      |
3.1. Terpenoids. Terpenoids are the most prevalent chemical class of the genus. About 125 compounds including 69 triterpenoids (1–69), 40 sesquiterpenes (70–109), 11 diterpenes (110–120), and 5 monoterpenes (121–125) are mainly identified from *P. flexuosus*, *P. reticulatus*, *P. watsonii*, *P. emblica*, *P. acuminatus*, and *P. veuminatus*. Compounds 1–14 are tetracyclic triterpenoids, and compounds 15–69 are pentacyclic triterpenoids. In pentacyclic triterpenoids, compounds 15–36, compounds 37–49, and compounds 50–65 are pentacyclic triterpenoids. In pentacyclic triterpenoids, compounds 15–36, compounds 37–49, and compounds 50–65 are oleanane type, friedelane type, and lupine type, respectively. Glochidone and lupeol are representatives of lupine type triterpenoids, which were suggested to have antitumor activities and mainly isolated from *Phyllanthus* species [68, 80, 96].

3.2. Phenylpropanoids. Phenylpropanoids (126–227) have typical C6–C3 constituents, which chiefly involve three groups including lignins, simple phenylpropanoids, and coumarins. 90 lignins (126–215) have been isolated from this genus and are characteristic compounds able to exhibit antioxidant, anti-HIV, antitumor, and antihyperalgesic activities [6, 111, 188, 195, 196, 199, 201, 202].

3.3. Tannins. Tannins were progressively reported from the genus *Phyllanthus* since 1992. Hydrolyzable tannins (228–270) are characterized by the presence of one or more galloyl, hexahydroxydiphenoyl (HHDP), and HHDP metabolites attached to a glucopyranose core, which are mainly isolated from *P. emblica*, *P. amarus*, *P. niruri*, and *P. urinaria*. Compounds 271–279 are condensed tannins, which are the condensation of flavan-3-ols and linked by C-C. A great many condensed tannins are proved to have antiviral activity [53]. Ellagitannins (232–270) are the largest group of hydrolyzable tannins. Corilagin and geraniin are most extensively obtained from this genus and are characteristic compounds of ellagitannins, which exhibited multiple activities such as antioxidant, anti-HIV, antitumor, and antihyperalgesic activities [6, 111, 188, 195, 196, 199, 201, 202].

3.4. Flavonoids. Compounds 281–334 are flavonoids, which mainly contain flavonol (280–309), flavones (310–317), flavonones (318–324), flavan-3-ols (325–330), flavanols (331), and isoflavone (332–333). Flavan-3-ols are the basic constitution of condensed tannins. Flavonols such as quercetin, quercitrin, and rutin demonstrated anti-inflammatory and antioxidant activities [151, 171, 178, 195, 203, 224].

3.5. Sterols. Until now, thirty sterols (334–363) from *Phyllanthus* have been reported. All the sterols are phytosterols with a side chain (C8–C10) substitution at C-17, and half of which were isolated from *P. emblica*.

3.6. Alkaloids. Thirty-two alkaloids (364–395) have been found in genus *Phyllanthus*, most of which are securirine and securine-related compounds and mainly distributed in *P. niruri*. Compounds 390–391 isolated from *P. fraternus* are amide type alkaloids and exhibited antimalarial potential [250].

3.7. Phenols and Others. Compounds 396–468 belong to phenols, which have one and several phenolic hydroxyl groups. Thirty other constitutions (469–512) have been isolated. Mucic acid (compounds 445–455) and its derivatives (compounds 498–499) can only be found in *P. emblica* among this genus.

4. Biological Activity

The remarkable traditional uses of genus *Phyllanthus* lead to the various researches of biological activities, such as antiviral, antioxidant, antidiabetic, anticancer, and immunomodulatory activities. In this section, biological activity researches of the extracts of the plants are highlighted.

4.1. Antiviral Activity. Various *Phyllanthus* plants were reported to have strong antiviral potential such as anti-HIV, anti-HCV, anti-HSV, and anti-HCMV. The aqueous extract of *P. emblica* reduced viral load of HIV significantly at the dose of 400 µg/mL [282]. DNA-polymerase and ribonuclease H (RNase H) activities of HIV-1 reverse transcriptase were inhibited by aqueous extract of *P. sellowianus* with IC<sub>50</sub> values of 2.4 ± 0.8 µg/mL and 5.9 ± 1.4 µg/mL, respectively [283]. Moreover, methanol extract of *P. reticulatus* strongly...
inhibited the activity of RNase H by 99% at the dose of 50 \( \mu \text{g/mL} \) [284].

HCV-infected HuH7 cells were used to test the anti-HCV activities of methanolic fraction of \( P. \) amarus. The fraction was proved to suppress the replication of HCV monomeric replicon RNA and HCV H77S viral RNA without toxic effect in host cells. Inhibiting HCV-NS3 protease enzyme and NS5B enzyme may be the main mechanism [285]. Aqueous extract of \( P. \) orbicularis revealed inhibition activity against the replication of HCMV, HSV-1, and HSV-2 as well as BHV-1 with \( EC_{50} \) values of 57.7, 28.8, 25.3, and 21.52 \( \mu \text{g/mL} \) respectively. The selectivity indexes (SI) were ranged from 8.7 to 37.6 [286, 287].

Friend murine leukemia virus (FMuLv) induced erythro-leukemia in BALB/c mice was relieved by metabolic extract of \( P. \) amarus. The extract inhibited leukemic cells from infiltrating into the sinusoidal space, decreased the morbidity of anemia, and improved survival rate of leukemia animals. Besides, the extract induced the upregulation of p53 and \( p45\text{NFE2} \) and downregulation of \( Bcl-2 \) in the spleen [288].

**4.2. Antioxidant Activity.** Methanolic and aqueous parts of this genus have remarkable antioxidant activity, which may be correlated with the hydroxyl rich compositions. \( P. \) acidus, \( P. \) polyphyllus, and \( P. \) fraternus showed remarkable hepatoprotective activity against liver toxicity which was induced by acetaminophen, carbon tetrachloride, bromobenzene, and thioacetamide [42, 289–291]. The biochemical parameters as well as antioxidants levels were restored by these parts at the dose of 300 mg/kg. What is more, mitochondrial dysfunction in liver, induced by bromobenzene, was relieved by prior oral administration of aqueous part of \( P. \) fraternus at the dose of 100 mg/kg [51, 291].

Antimycin A governed mitochondrial protein degeneration, lipid peroxidation and mitochondrial DNA damage, and \( \text{H}_2\text{O}_2 \) induced membrane damage of Hep3B cells were considerably mitigated by aqueous fraction of \( P. \) amarus [164]. Mutagenesis induced by PhIP and 4-ABP and DNA damage induced by \( \gamma \)-ray and UVB were protected by aqueous fraction of \( P. \) orbicularis [292–294].

Methanol extract of \( P. \) debilis showed strong antioxidant activity when tested by various antioxidant assays including total antioxidant, free radical scavenging, superoxide anion radical scavenging, hydrogen peroxide scavenging, and nitric oxide scavenging assays. Besides, further study demonstrated that total phenolic was correlated with antioxidant activity [52]. In addition, hydromethanolic extract of \( P. \) virgatus exhibited substantially antioxidant capacity in both DPPH scavenging (\( IC_{50} = 30.4 \mu\text{g/mL} \)) and linoleic acid oxidation inhibiting (84%) method [5].

**4.3. Antidiabetic Activity.** Twelve herb drugs such as \( P. \) emblica, \( P. \) reticulatus, \( P. \) sellowianus, \( P. \) virgatus, \( P. \) amarus, \( P. \) urinaria, \( P. \) acidus, \( P. \) debilis, \( P. \) sellowianus, \( P. \) rheedia, \( P. \) orbicularis, and \( P. \) hookeri are traditionally employed for diabetes in many countries. Recent researches about the hypoglycemic effect of \( Phyllanthus \) plants were abundant. Streptozotocin- and alloxan-induced diabetic rats were employed for the evaluation of antidiabetic potential of \( P. \) emblica, \( P. \) niruri, \( P. \) reticulatus, \( P. \) sellowianus, \( P. \) virgatus, and \( P. \) simplex [4, 295–299]. After oral administration of these (aqueous, methanol, and ethanol) extracts for 21–45 days, the concentration of blood glucose was significantly reduced, and the effects of \( P. \) sellowianus and \( P. \) simplex were similar to the glibenclamide group (10 mg/kg). In addition, methanol fraction of \( P. \) virgatus considerably inhibited the activity of \( \alpha \)-amylase in the noncompetitive pattern with \( IC_{50} \) of 33.20 ± 0.556 \( \mu\text{g/mL} \) [300].

After oral aqueous extract of \( P. \) niruri for 28 days, the levels of LPO and MDA were decreased while the concentrations of SOD, CAT, and GPx were increased. After being pretreated with the aqueous fraction of \( P. \) sellowianus, hemorheological parameters were ameliorated and red blood cells (RBCs) showed large globular aggregates and agglutination [301].

**4.4. Anticancer Activity.** Different extracts of the plants have been assessed for anticancer effects and the related mechanisms. Cancer cell lines such as NCI-H703, MDA-MB-231, Hela, 143B, PC-3, MCF-7, HepG2, A549, SKOV3, and HT-29 were considerably inhibited by \( P. \) emblica, \( P. \) urinaria, \( P. \) polyphyllus, \( P. \) watsonii, and \( P. \) pulcher [57, 68, 302–309]. In addition, \( P. \) emblica showed no toxicity to normal cells (MRC5). The extracts inhibited growth of cells through fragmentation of DNA and dysfunction of mitochondrial including upregulated mitochondrial fission 1 protein and downregulated optic atrophy type 1 and mitofusin 1 [304]. Moreover, the extracts suppressed the ability of cell invasion, migration, and adhesion. Further researches demonstrated that the fractions induced apoptosis, invasion, and migration through increasing the expression of caspase-3, caspase-7, caspase-8, and \( \text{p-JNK} \) and decreasing the expression of ERK, p-ERK1/2, p-JNK, and hypoxia [302, 303, 307].

Ehrlich ascites carcinoma tumor model was used to evaluate the antitumor activity of \( P. \) polyphyllus. Oral administration of methanol fraction at the dose of 200 mg/kg could significantly reduce the solid tumor volume. Hematological parameters, protein, packed cellular volume (PCV), and hypoxia [302, 303, 307].

**4.5. Immunomodulatory Activity.** Ethanol extracts of \( P. \) urinaria and \( P. \) amarus were demonstrated to have inhibitory effects on the chemotaxis of neutrophils and monocytes with \( IC_{50} \) lower than 2.92 \( \mu\text{g/mL} \). In addition, phagocytic activity and CD18 expression of neutrophils and monocytes were downregulated [163].

Oral administration of \( P. \) reticulatus extract at the dose of 100 mg/kg demonstrated a significant increase in phagocytic activity, the percentage of neutrophil adhesion, and white blood cell in albino mice [310].

**4.6. Analgesic Activity.** The extracts of \( P. \) corcovadensis, \( P. \) niruri, and \( P. \) tenellus showed significant reduction in writhing response induced by acetic acid, with \( \text{ID}_{50} \) values of 30, 19, and >30 mg/kg, respectively. The late phase of formalin-induced pain could be relieved by \( P. \) tenellus with \( \text{ID}_{50} \) of 100 mg/kg and both phases of formalin-induced pain could
be reduced by *P. corcovadensis* and *P. niruri* with ID$_{50}$ values of 100 and 52 mg/kg, respectively. The analgesic effects could not be antagonized by naloxone [311]. In addition, intraperitoneally given hydroalcoholic extracts of *P. amarus*, *P. orbicularis*, and *P. fraternus* produced a marked analgesic activity by inhibiting acetic acid-induced abdominal constriction, capsaicin-induced neurogenic pain, and late phase of formalin-induced paw licking [312]. The ethanol and aqueous extracts of *P. emblica* succeeded in inhibiting acetic acid-induced writhing response but failed in the tail-immersion test [313].

4.7. Anti-Inflammatory Activity. In recent years, different inflammatory models such as Freund’s complete adjuvant induced arthritis, carrageenin induced paw edema, and cotton pellet induced granuloma were employed to evaluate the anti-inflammatory effect of *Phyllanthus*. After receiving the aqueous extract of *P. amarus*, indexes of arthritis, joint diameter, and paw volume were decreased and thresholds of mechanical hyperalgesia and nociceptive were increased [314]. The ethanol fraction of *P. simplx* ameliorated the parameters of paw edema and granuloma and substantially inhibited nitric oxide (NO) production [315].

4.8. Antispasmodic Activity. Isolated rabbit jejunum and guinea-pig ileum were employed for the in vitro tests for the antispasmodic effects of *P. emblica*. Carbachol and K$^+$ induced contractions of rabbit jejunum were released by the extract with IC$_{50}$ values of 0.09 mg/mL and 1.38 mg/mL. The pretreatment of guinea-pig ileum with the extract at 0.3 mg/mL caused a rightward parallel shift in the concentration-response curves of acetylcholine without suppression of the maximum contractile response. Dual blockade of muscarinic receptors and Ca$^{2+}$ channels can explain its antispasmodic activity [316].

4.9. Hypotensive and Hypolipidemic Activity. Aqueous extract of the leaves of *P. amarus* was found to restrain both force and rate of myocardial contraction and to inhibit the intrinsic myogenic contraction of isolated rat portal vein [317]. Aqueous part of *P. reticulatus* was effective in releasing total cholesterol, lipid profile, and oxidative stress in hypercholesterolemic albino rats after oral administration for 45 days at 250 mg/kg [14].

4.10. Wound Healing. Extracts of *P. emblica* and *P. niruri* were demonstrated to have wound healing effect. Topical application with *P. emblica* could promote the proliferation of cells and cross-link of collagen in the full thickness excision wound [318]. Oral administration of *P. emblica* at the dose of 60 mg/kg showed healing effect against NSAID-induced gastric ulcer through upregulating the concentration of IL-10 and downregulating the levels of TNF-$\alpha$ and IL-1$\beta$ [319]. After treatment with *P. niruri* at the dose of 200 mg/kg, 98.8% of wound could be recovered in the excision and incision wound models on the 16th day [320].

4.11. Antimalarial Activity. Malaria is a prevalent disease in many tropical and subtropical countries and folks of these places especially African people employed *Phyllanthus* as antimalarial agency. *Plasmodium falciparum* was suppressed by ethyl acetate fraction of *P. acidus* with IC$_{50}$ of 9.37 $\mu$g/mL, and the SI equals 4.88 for HeP-2 cells and 11.75 for Vero cells [321]. What is more, chloroquine-resistant *P. falciparum* could be exhibited by *P. amarus* and *P. muellerianus* with IC$_{50}$ values of 11.7 and 9.4 $\mu$g/mL, respectively. *P. amarus* presented protection effect on human RBCs damage caused by the virus [322]. The SI of *P. muellerianus* was higher than 5.3 for L-6 and MRC-5 cell lines [25, 202].

4.12. Antidepressant Activity. The aqueous extract of *P. emblica* (200 mg/kg) significantly decreased immobility period in both tail suspension test and forced swim test by decreasing the levels of MAO-A and GABA [323]. In the plus-maze, Hebb-Williams maze, and passive avoidance apparatus test, preparation of *P. emblica* produced a dose-dependent upgrade in scores. The preparation was also proved to reverse the amnesia induced by diazepam and scopolamine and to reduce the cholinesterase activity and total cholesterol level in brain [324, 325].

4.13. Others. The essential oil fraction of *P. muellerianus* exhibited strong antibacterial activity against *Clostridium sporogenes*, *Streptococcus mutans*, and *S. pyogenes* with MIC values ranging from 13.5 to 126 $\mu$g/mL [326]. Methanol extract of *P. acuminatus* (100 mg/mL) showed stronger antifungal than Dithane M-45 (10 000-ppm solution) against *Pythium ultimum* [327].

Aqueous extract of *P. acidus* was proved to regulate electrolyte transport in cystic fibrosis airways by increasing the intracellular levels of cAMP and Ca$^{2+}$, stimulating basolateral K$^+$ channels, and activating and redistributing cellular localization of cystic fibrosis transmembrane conductance regulator [328].

Eight hours after being treated with the aqueous extract of *P. sellowianus* at a dose of 400 mg/kg, urine output of test animals was decreased from 2.59 to 3.69 mL/100 g [329].

5. Clinical Studies

The extracts of *P. niruri* were proved to have immunomodulatory effect and played a crucial role in treating pulmonary tuberculosis and vaginal candidiasis as well as varicella. In patients with pulmonary tuberculosis, after oral administration of *P. niruri* 50 mg/mL for 2–6 months, the level of IL-10 was decreased and the levels of plasma IFN-$\gamma$ and TNF-$\alpha$ were significantly increased. After 1-month treatment, the increase of the ratio of CD4$^+$/CD8$^+$ was observed. In the vaginal candidiasis patients, after receiving *P. niruri* 100 mg/mL for 1–3 months, the levels of IFN-$\gamma$ and IL-12 were elevated. As for varicella patients, the number of papules and the number crusts were decreased after treatment with the extract at the dose of 5 mg/mL [330].

Clinical studies of *P. niruri* in Brazil had been finished, from which the *P. niruri* showed beneficial effects on the treatment of urolithiasis. After 3-month treatment, calculi elimination was increased. Furthermore, urinary calcium excretion and residual stone fragments after lithotripsy were decreased. Toxic effects on kidney, cardiovascular, and nervous systems were not found [331].
In China, the clinical study of *P. urinaria* in treating chronic hepatitis B with 140 patients was well established. The results indicated that, after treatment with *P. urinaria* capsule for 3 months or 2 years, especially in the long term, the recovery rate in the index of HBV-DNA and HBeAg was 88.2% and 52.5%, respectively. Once the treatment stopped, the recurrence rate was 10.4% to 13.4% [332].

6. Toxicity Studies

After given aqueous leaf extract of *P. niruri* at the dose of 2000 mg/mL, no acute toxicity was observed at the levels of bilirubin, ALT, AST, total protein, albumin, globulin, ALP, GGT, urea, creatinine, full blood count, and hemoglobin [333]. After being treated with ethanol extract of *P. niruri* over a period of 90 days at doses of 30 and 300 mg/kg, the rats showed no genotoxic effect at the test of PCE/NCE ratio [334]. Reproductive toxicity of *P. niruri* was tested using estrogen values, progesterone values, and testosterone levels. The estrogen and progesterone levels increased more than 1.5-fold above the control group after receiving 50 and 500 mg/kg aqueous leaf extract for 90 days, which reminded us of the cytotoxicity of male antifertility properties [335].

Nephrotoxicity including interstitial oedema and tubular necrosis were detected after receiving 400 and 800 mg/kg of aqueous extract from *P. amarus* for 30 days [336]. The test animals were given 800 and 1600 mg/kg of the aqueous extract of *P. amarus* for 10 days, and significant pathological changes were found in the liver, kidney, and testis. The frequency of MNPCE, sperm abnormalities, and lymphocyte counts were significantly increased, which suggested the genetic and systemic toxicity of *P. amarus* [337]. In addition, aqueous, methanolic, and hydromethanolic extracts of *P. amarus* (400 mg/kg) reduced locomotor activity and showed CNS depressant effect [338].

The LD<sub>50</sub> of ethanolic extract from *P. fraternus* was 1125 mg/kg in the toxicity test. When the rats received the extract at doses of 400 mg/kg for 7 days, no toxicity was detected in liver and kidney [339]. Hydroethanolic extract *P. fraternus* showed the quick onset and long duration of reduction of locomotor activity at the dose of 400 mg/kg [338].

7. Conclusion

514 compounds have been isolated from different species of *Phyllanthus*, including 126 terpenoids, 102 phenylpropanoids, 73 phenols, 54 flavonoids, 53 tannins, 33 sterols, 31 alkaloids, and a number of other compositions. Their wide range of biological activities such as antiviral, antioxidant, antidiabetic, anticancer, anti-inflammatory, hypolipidemic, immunomodulatory, and antidepressant activities are tested using polar solvents (water, methanol, and ethanol) extracts. These extracts are considered rich in phenols, flavonoids, and tannins, which may exhibit antioxidant activity in different degree due to their hydroxyl [340]. Consequently, most bioactivities of *Phyllanthus* may be correlated with the hydroxyl rich compounds.

In recent years, the traditional uses of *Phyllanthus* had been partly confirmed, and more evidences such as pharmacological researches and clinical studies are urgently needed to be taken. Further studies of phytochemical discovery and subsequent screenings are necessary to be taken to extend the use of *Phyllanthus* and to develop leading compound.

Competing Interests

The authors declare that they have no competing interests.

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References

[1] D. W. Unander, G. L. Webster, and B. S. Blumberg, “Usage and bioassays in *Phyllanthus* (Euphorbiaceae). IV. Clustering of antiviral uses and other effects,” Journal of Ethnopharmacology, vol. 45, no. 1, pp. 1–18, 1995.
[2] Q. Xia, A pharmacognostic and ethnopharmacological studies of *Chinese phyllanthus* [Ph.D. thesis], Peking Union Medical College, Beijing, China, 1997.
[3] M. D. Adil, P. Kaiser, N. K. Satti, A. M. Zargar, R. A. Vish-wakarma, and S. A. Taduq, “Effect of *Emblca officinalis* (fruit) against UVB-induced photo-aging in human skin fibroblasts,” Journal of Ethnopharmacology, vol. 132, no. 1, pp. 109–114, 2010.
[4] P. Nain, V. Saini, S. Sharma, and J. Nain, “Antidiabetic and antioxidant potential of *Emblca officinalis* Gaertn. leaves extract in streptozotocin-induced type-2 diabetes mellitus (T2DM) rats,” Journal of Ethnopharmacology, vol. 142, no. 1, pp. 65–71, 2012.
[5] K. Poompachee and N. Chudaongse, “Comparison of the antioxidant and cytotoxic activities of *Phyllanthus virgatus* and *Phyllanthus amarus* extracts,” Medical Principles and Practice, vol. 21, no. 1, pp. 24–29, 2011.
[6] J. Moreira, L. C. Klein-Júnior, V. Cechinel Filho, and F. de Campos Buzzii, “Anti-hyperalgesic activity of coralgain, a tannin isolated from *Phyllanthus niruri* L. (Euphorbiaceae),” Journal of Ethnopharmacology, vol. 146, no. 1, pp. 318–323, 2013.
[7] E. Omukokoli, B. Khan, and S. C. Chhabra, “Antiplasmodial activity of four Kenyan medicinal plants,” Journal of Ethnopharmacology, vol. 56, no. 2, pp. 133–137, 1997.
[8] Q. Xia, P. Xiao, L. Wang, and J. Kong, “Ethnopharmacology of *Phyllanthus emblica* L., Zhongguo Zhongyao Zazhi,” vol. 22, no. 9, pp. 515–525, 1997.
[9] M. Ishiaq, W. Hanif, M. A. Khan, M. Ashraf, and A. M. Butt, “An ethnomedicinal survey and documentation of important medicinal folklore food phytonims of flora of Samahnai valley, (Azad Kashmir) Pakistan,” Pakistan Journal of Biological Sciences, vol. 10, no. 13, pp. 2241–2256, 2007.
[10] K. Kumar, W. Runseveijitprapa, N.-A. Narkkhong, M. Suttajit, and C. Chaiyasut, “5α-reductase inhibition and hair growth promotion of some Thai plants traditionally used for hair treatment,” Journal of Ethnopharmacology, vol. 139, no. 3, pp. 765–771, 2012.
L. Tona, N. P. Ngimbi, M. Tsakala et al., “Antimalarial activity of African plants used for treatment of malaria,” *Journal of Ethnopharmacology*, vol. 14, no. 11, pp. 1073–1077, 2012.

S. Das, S. Das, and B. De, “In vitro inhibition of key enzymes related to diabetes by the aqueous extracts of some fruits of West Bengal, India,” *Current Nutrition and Food Science*, vol. 8, no. 1, pp. 19–24, 2012.

C. Agyare, A. Asase, M. Lechtenberg, M. Niehues, A. Deters, and A. Hensel, “An ethnopharmacological survey and in vitro confirmation of ethnopharmacological use of medicinal plants used for wound healing in Bosomtwi-Atwima-Kwanwoma area, Ghana,” *Journal of Ethnopharmacology*, vol. 125, no. 3, pp. 393–403, 2009.

A. O. Eweka and A. Enogieru, “Effects of oral administration of Phyllanthus niruri leaf extract on the kidneys of adult wistar rats- a histological study,” *African Journal of Traditional, Complementary and Alternative Medicines*, vol. 8, no. 3, pp. 307–311, 2011.

S. Khatoon, V. Rai, A. K. S. Rawat, and S. Mehrotra, “Comparative pharmacognostic studies of three Phyllanthus species,” *Journal of Ethnopharmacology*, vol. 104, no. 1-2, pp. 79–86, 2006.

P. Keluskar and S. Iingle, “Ethnopharmacological guided screening of traditional Indian herbs for selective inhibition of Plasmodium specific lactate dehydrogenase,” *Journal of Ethnopharmacology*, vol. 144, no. 1, pp. 201–207, 2012.

J. R. Patel, P. Tripathi, V. Sharma, N. S. Chauhan, and V. K. Dixit, “Phyllanthus niruri: ethnomedicinal uses, phytochemistry and pharmacology: a review,” *Journal of Ethnopharmacology*, vol. 138, no. 2, pp. 286–313, 2011.

J. R. Xavier, R. Gnanam, M. P. Murugan, and A. Pappachan, “Clonal propagation of Phyllanthus niruri: a hepatoprotector,” *Pharmacognosy Magazine*, vol. 8, no. 29, pp. 78–82, 2012.

I. G. Tamil, B. Dineshkumar, M. Nandhakumar, M. Senthilkumar, and A. Mitra, “In vitro study on α-amylase inhibitory activity of an Indian medicinal plant, Phyllanthus amarus,” *Indian Journal of Pharmacology*, vol. 42, no. 5, pp. 280–282, 2010.

A. Komuraiah, K. Bolla, K. N. Rao, A. Ragan, V. S. Rajum, and M. A. Singara Charya, “Antibacterial studies and phytochemical analysis of South Indian medicinal plants used in Karnataka, India,” *Journal of Ethnopharmacology*, vol. 68, no. 1–3, pp. 193–203, 1999.

K. Narendra, J. Swathi, K. Sowjanya, and A. Satya, “Phyllanthus niruri: a review on its ethno botanical, phytochemical and pharmacological profile,” *Journal of Pharmacy Research*, vol. 5, no. 9, pp. 4681–4691, 2012.

G. Bagalkotkar, S. R. Sagineedu, M. S. Saad, and J. Stanslas, “Phytochemicals from Phyllanthus niruri Linn. and their pharmacological properties: a review,” *Journal of Pharmacy and Pharmacology*, vol. 58, no. 12, pp. 1559–1570, 2006.

N. A. Shakil, Pankaj, J. Kumar, R. K. Pandey, and D. B. Saxena, “Nematicidal prenylated flavanones from Phyllanthus niruri,” *Phytochemistry*, vol. 69, no. 3, pp. 759–764, 2008.

V. Murugaiyah and K.-L. Chan, “Mechanisms of antihyperuricemic effect of Phyllanthus niruri and its lignan constituents,” *Journal of Ethnopharmacology*, vol. 124, no. 2, pp. 233–239, 2009.

G. N. Ziriri, L. Mambu, F. Guédé-Guina, B. Bodo, and P. Grellier, “In vitro antiplasmodial activity and cytotoxicity of 33 West African plants used for treatment of malaria,” *Journal of Ethnopharmacology*, vol. 98, no. 3, pp. 281–285, 2005.
Y.-J. Zhang, T. Tanaka, Y. Iwamoto, C.-R. Yang, and I. Kouno, "Novel sesquiterpenoids from the roots of *Phyllanthus emblica*," *Journal of Natural Products*, vol. 66, no. 2, pp. 1507–1510, 2000.

Y.-J. Zhang, T. Nagao, T. Tanaka, C.-R. Yang, H. Okabe, and I. Kouno, "Antiproliferative activity of the main constituents from *Phyllanthus emblica*," *Biological and Pharmaceutical Bulletin*, vol. 27, no. 2, pp. 251–255, 2004.

Y.-F. Wang, X.-Y. Wang, Z. Ren et al., "Phyllaembolin B inhibits Coxsackie virus B3 induced apoptosis and myocarditis," *Antiviral Research*, vol. 84, no. 2, pp. 150–158, 2009.

Q. Liu, Y.-F. Wang, R.-J. Chen et al., "Anti-coxsackievirus B3 sesquiterpenoids from the roots of *Phyllanthus emblica*," *Journal of Natural Products*, vol. 72, no. 5, pp. 969–972, 2009.

Y. Zhang, L. Zhao, X. Guo et al., "Chemical constituents from *Phyllanthus emblica* and the cytoprotective effects on H₂O₂-induced PC12 cell injuries," *Archives of Pharmacal Research*, 2014.

S. M. Kupchan, E. J. LaVoie, A. R. Branfman, B. Y. Fei, W. M. Bright, and R. F. Bryan, "Tumor inhibitors. 120. Phyllanthocin, a novel bisabolane aglycone from the antileukemic glycoside, phyllanthoside," *Journal of the American Chemical Society*, vol. 99, no. 9, pp. 3199–3201, 1977.

G. R. Pettit, G. M. Cragg, D. Gust, P. Brown, and J. M. Schmidt, "The structures of phyllanthosatin 1 and phyllanthoside from the central american tree *Phyllanthus acuminatus vahl*," *Canadian Journal of Chemistry*, vol. 60, no. 7, pp. 939–941, 1982.

G. R. Pettit, G. M. Cragg, D. Gust, and P. Brown, "The isolation and structure of phyllanthostatins 2 and 3," *Canadian Journal of Chemistry*, vol. 60, no. 4, pp. 544–546, 1982.

M.-S. Lan, J.-X. Ma, C.-H. Tan, S. Wei, and D.-Y. Zhu, "Chemical constituents of *Phyllanthus reticulatus*," *Helvetcia Chimica Acta*, vol. 93, no. 11, pp. 2276–2280, 2010.

J.-Q. Zhao, J.-J. Lv, Y.-M. Wang et al., "Phyllanflexoid C: first example of phenylacetylene-bearing 18-nor-diterpenoid glycoside from the roots of *Phyllanthus flexuosus*," *Tetrahedron Letters*, vol. 54, no. 35, pp. 4670–4674, 2013.

M. A. Hossain and S. M. Salehuddin, "Diterpenes from the leaves of *Phyllanthus niruri*," *Indian Journal of Natural Products*, vol. 22, no. 2, pp. 18–20, 2006.

J. Gupta and M. Ali, "Isolation of rare phytococonstituents from *Phylanthus fraternus* roots," *Journal of Medicinal and Aromatic Plant Sciences*, vol. 21, pp. 352–357, 1999.

B. Singh, P. K. Agrawal, and R. S. Thakur, "Studies on medicinal-plants 33. Isolation of trans-phytol from *Phyllanthus niruri*," *Planta Medica*, vol. 57, no. 1, p. 98, 1991.

Y. L. Ren, D. D. Lantvit, Y. C. Deng et al., "Potent cytotoxic arylnaphthalene lignan lactones from *Phyllanthus poilanei*," *Journal of Natural Products*, vol. 77, no. 6, pp. 1494–1504, 2014.

P. Tuchinda, A. Kumkao, M. Pohmakot, S. Sophasan, T. Santisuk, and V. Neutrakul, "Cytotoxic arylnaphthalide lignan glycosides from the aerial parts of *Phyllanthus taxoidifolius*," *Planta Medica*, vol. 72, no. 1, pp. 60–62, 2006.

C.-C. Chang, Y.-C. Lien, K. C. S. C. Liu, and S.-S. Lee, "Lignans from *Phyllanthus urinaria*," *Phytochemistry*, vol. 63, no. 7, pp. 825–833, 2003.

Y. K. Rao, S.-H. Fang, and Y.-M. Tseng, "Anti-inflammatory activities of constituents isolated from *Phyllanthus polyphyllus*," *Journal of Ethnopharmacology*, vol. 103, no. 2, pp. 181–186, 2006.

R. A. Hussain, J. K. Dickey, M. P. Rosser et al., "A novel class of non-peptidic endothelin antagonists isolated from the medicinal herb *Phyllanthus niruri*," *Journal of Natural Products*, vol. 58, no. 10, pp. 1515–1520, 1995.

P. A. Ganeshpure, G. E. Schneider, and R. Stevenson, "Structure and synthesis of hypophyllanthin, nirtetralin, phyltetralin and lintetralin," *Tetrahedron Letters*, vol. 22, no. 5, pp. 393–396, 1981.

K. V. Syamasundar, B. Singh, R. Singh Thakur, A. Husain, K. Yoshinobu, and H. Hiroshi, "Antihepatotoxic principles of *Phyllanthus niruri* herbs," *Journal of Ethnopharmacology*, vol. 14, no. 1, pp. 41–44, 1985.

M. Inchoo, H. Chirdchupunseree, P. Pramyothin, and S. Jianmongkol, "Endothelium-independent effects of phyllanthin and hypophyllanthin on vascular tension," *Fitoterapia*, vol. 82, no. 8, pp. 1231–1236, 2011.

Y.-L. Huang, C.-C. Chen, F.-L. Hsu, and C.-F. Chen, "A new lignan from *Phyllanthus virgatus*," *Journal of Natural Products*, vol. 59, no. 5, pp. 520–521, 1996.

M. Singh, N. Tiwari, K. Shanker, R. K. Verma, A. K. Gupta, and M. M. Gupta, "Two new lignans from *Phyllanthus amarus*," *Journal of Asian Natural Products Research*, vol. 11, no. 6, pp. 562–568, 2009.

A. Islam, T. Selvan, U. K. Mazumder, M. Gupta, and S. Ghosal, "Antitumour effect of phyllanthin and hypophyllanthin from *Phyllanthus amarus* against Ehrlich ascites carcinoma in mice," *Pharmacologynline*, vol. 2, pp. 796–807, 2008.

T. Taesotikul, W. Dumrongskulchai, N. Wattanachai et al., "Inhibitory effects of *Phyllanthus amarus* and its major lignans on human microsomal cytochrome P450 activities: evidence for CYP3A4 mechanism-based Inhibition," *Drug Metabolism and Pharmacokinetics*, vol. 26, no. 2, pp. 154–161, 2011.

K. S. Chandrareskar, D. Satyanarayana, A. B. Joshi, and E. V. S. Subrahmanyam, "Phytochemical studies of *Phyllanthus debilis*," *Natural Product Sciences*, vol. 10, no. 3, pp. 101–103, 2004.

Y. L. Huang, C. C. Chen, and J. C. Ou, "Isolintetralin: a new lignan from *Phyllanthus niruri*," *Planta Medica*, vol. 58, no. 5, pp. 473–474, 1992.

M.-T. Lin, S.-S. Lee, and K. C. S. Chen Liu, "Phyllamyricins A-C, three novel lignans from *Phyllanthus myrtifolius*," *Journal of Natural Products*, vol. 58, no. 2, pp. 244–249, 1995.

T. L. Bachmann, F. Ghia, and K. B. G. Torssell, "Lignans and lactones from *Phyllanthus anisolobus*," *Phytochemistry*, vol. 33, no. 1, pp. 189–191, 1993.

J. Gertsch, R. T. Tobler, R. Brun, O. Sticher, and J. Heilmann, "Antifungal, antiprotozoal, cytotoxic and piscidical properties of justicidin B and a new arylnaphthalide lignan from *Phyllanthus piscatorius*," *Planta Medica*, vol. 69, no. 5, pp. 420–424, 2003.
W.-X. Wei, X.-G. Gong, O. Ishrud, and Y.-J. Pan, "New lignan isolated from Phyllanthus niruri Linn. structure elucidation by NMR spectroscopy," Bulletin of the Korean Chemical Society, vol. 23, no. 6, pp. 896–898, 2002.

N. V. Thanh, P. T. T. Huong, N. H. Nam et al., "A new flavone sulfonyl acid from Phyllanthus urinaria," Phytochemistry Letters, vol. 7, no. 1, pp. 182–185, 2014.

W. X. Wei, X. R. Li, K. W. Wang, Z. W. Zheng, and M. Zhou, "Lignans with anti-hepatitis B virus activities from Phyllanthus niruri L.," Phytotherapy Research, vol. 26, no. 7, pp. 964–968, 2012.

R.-L. Huang, Y.-L. Huang, J.-C. Ou, C.-C. Chen, F.-L. Hsu, and C. Chang, "Screening of 25 compounds isolated from Phyllanthus species for anti-human hepatitis B virus in vitro," Phytotherapy Research, vol. 17, no. 5, pp. 449–453, 2003.

D. F. F. Leite, C. A. L. Kassuya, T. L. Mazzuco et al., "The cytotoxic effect and the multidrug resistance reversing action of lignans from Phyllanthus amarus," Planta Medica, vol. 72, no. 15, pp. 1533–1538, 2006.

C. A. L. Kassuya, D. F. F. Leite, L. V. de Melo, V. L. G. Rehder, and J. B. Calixto, "Anti-inflammatory properties of extracts, fractions and lignans isolated from Phyllanthus amarus," Planta Medica, vol. 71, no. 8, pp. 721–726, 2005.

S. Liu, W. X. Wei, Y. B. Li et al., "In vitro and in vivo anti-hepatitis B virus activities of the lignan nirtetralin B isolated from Phyllanthus niruri L.," Journal of Ethnopharmacology, vol. 157, pp. 62–68, 2014.

S.-S. Lee, M.-T. Lin, C.-L. Liu, Y.-Y. Lin, and K. C. S. C. Liu, "Six lignans from Phyllanthus myrtifolius," Journal of Natural Products, vol. 59, no. 11, pp. 1061–1065, 1996.

G. R. Petit and D. E. Schaufelberger, "Isolation and structure of the cytostatic lignan glycoside phyllanthostatin A," Journal of Natural Products, vol. 51, no. 6, pp. 1104–1112, 1988.

J.-Q. Zhao, Y.-M. Wang, J.-J. Lv et al., "New phenolic glycosides from Phyllanthus cochinichensis," Journal of the Brazilian Chemical Society, vol. 25, no. 8, pp. 1446–1454, 2014.

S.-J. Wu and T.-S. Wu, "Cytotoxic arylnaphthalene lignans from Phyllanthus oligospermus," Chemical & Pharmaceutical Bulletin, vol. 54, no. 8, pp. 1223–1225, 2006.

S.-H. Fang, Y. K. Rao, and Y.-M. Tzeng, "Anti-oxidant and inflammatory mediator's growth inhibitory effects of compounds isolated from Phyllanthus urinaria," Journal of Ethnopharmacology, vol. 116, no. 2, pp. 333–340, 2008.

C.-Y. Wang, S.-W. Sun, and S.-S. Lee, "Pharmacokinetic and metabolic studies of retrojucidin B, a potential anti-viral lignan, in rats," Planta Medica, vol. 70, no. 12, pp. 1161–1165, 2004.

C.-Y. Wang, S.-W. Sun, and S.-S. Lee, "Pharmacokinetic and metabolic studies of retrojucidin B, a potential anti-viral lignan, in rats," Planta Medica, vol. 70, no. 12, pp. 1161–1165, 2004.

P. Satyanarayana, P. Subrahmanyan, K. N. Viswanathan, and R. S. Ward, "New sec- and hydroxy-lignans from Phyllanthus niruri," Journal of Natural Products, vol. 51, no. 1, pp. 44–49, 1988.

E. Elfahmi, A. Koulima, R. Bos, and H. J. Woerdenberg, "Lignans from cell suspension cultures of Phyllanthus niruri, an Indonesian medicinal plant," Journal of Natural Products, vol. 69, no. 1, pp. 55–58, 2006.

P. Satyanarayana and S. Venkateswarlu, "Isolation, structure and synthesis of new dihydrobenzyl-lignans from Phyllanthus niruri: synthesis of 5’-desmethoxy niranthin and an antitumour extractive," Tetrahedron, vol. 47, no. 42, pp. 8931–8940, 1991.

P. Giridharan, S. T. Somasundaram, K. Perumal et al., "Novel substituted methylenedioxy lignan suppresses proliferation of cancer cells by inhibiting telomerase and activation of c-myc and caspasas leading to apoptosis," British Journal of Cancer, vol. 87, no. 1, pp. 98–105, 2002.

B. Singh, P. K. Agrawal, and R. S. Thakur, "Chemical-constituents of Phyllanthus niruri Linn," Indian Journal of Chemistry, Section B—Organic Chemistry Including Medicinal Chemistry, vol. 25, no. 6, pp. 600–602, 1986.

C. A. L. Kassuya, A. Silvestre, O. Menezes-de-Lima Jr., D. M. Marotta, V. L. G. Rehder, and J. B. Calixto, "Antinflammatory and antiallodynic actions of the lignan niranthin isolated from Phyllanthus amarus. Evidence for interaction with platelet activating factor receptor," European Journal of Pharmacology, vol. 546, no. 1–3, pp. 182–188, 2006.

S. Chowdhury, T. Mukherjee, R. Mukhopadhyay et al., "The lignan niranthin poisons Leishmania donovani topoisomerase IB and favours a Th1 immune response in mice," EMBO Molecular Medicine, vol. 4, no. 10, pp. 1126–1143, 2012.

B. Singh, P. K. Agrawal, and R. S. Thakur, "A new lignan and a new neolignan from Phyllanthus niruri," Journal of Natural Products, vol. 52, no. 1, pp. 48–51, 1989.

K. L. Ooi, S. I. Loh, M. A. Sattar, T. S. T. Muhammad, and S. F. Sulaiman, "Cytotoxic, caspase-3 induction and in vivo hepatoprotective effects of phyllanthin, a major constituent of Phyllanthus niruri," Journal of Functional Foods, vol. 14, pp. 236–243, 2015.

V. Murugaiyah and K.-L. Chan, "Antihyperuricemic lignans from the leaves of Phyllanthus niruri," Planta Medica, vol. 72, no. 14, pp. 1262–1267, 2006.

I. Jantan, M. Ilangkovan, Yuandani, and H. F. Mohamad, "Correlation between the major components of Phyllanthus amarus and Phyllanthus urinaria and their inhibitory effects on phagocytic activity of human neutrophils," BMC Complementary and Alternative Medicine, vol. 14, article 429, 2014.

G. Guha, T. Mandal, V. Rajkumar, and R. Ashok Kumar, "Anti-mycin A-induced mitochondrial apoptotic cascade is mitigated by phenolic constituents of Phyllanthus amarus aqueous extract in Hep3B cells," Food and Chemical Toxicology, vol. 48, no. 12, pp. 3449–3457, 2010.

H. Chirdchupunseree and P. Pramyothin, "Protective activity of phyllanthin in ethanol-treated primary culture of rat hepatocytes," Journal of Ethnopharmacology, vol. 128, no. 1, pp. 172–176, 2010.

C.-H. Kuo, S.-S. Lee, H.-Y. Chang, and S.-W. Sun, "Analysis of lignans using micellar electrokinetic chromatography," Electrophoresis, vol. 24, no. 6, pp. 1047–1053, 2003.

Y. W. Chen, L. J. Ren, K. M. Li, and Y. W. Zhang, "Isolation and identification of novel polyphenolic compound from Phyllanthus urinaria," Acta Pharmaceutica Sinica, vol. 34, no. 7, pp. 526–529, 1999.

O. Hnatyszyn, G. Ferraro, and J. D. Coussio, "Constituents of Phyllanthus sellowianus," Fitoterapia, vol. 66, no. 6, p. 543, 1995.

C. Agyre, M. Lechtenberg, A. Deters, F. Peteret, and A. Hensel, "Ellagittannins from Phyllanthus muellerianus (Kuntze) Exell.: Geraniin and furisorin stimulate cellular activity, differentiation and collagen synthesis of human skin keratinocytes and dermal fibroblasts," Phytomedicine, vol. 18, no. 7, pp. 617–624, 2011.

X. Niu, L. Qi, W. Li, and X. Liu, "Simultaneous analysis of eight polyphenolic compounds in Phyllanthus simplex Retz by HPLC-DAD-ESI/MS," Journal of Medicinal Plants Research, vol. 6, no. 9, pp. 1512–1518, 2012.

W. Luo, M. Zhao, B. Yang, G. Shen, and G. Rao, "Identification of bioactive compounds in Phyllanthus emblica L. fruit and their free radical scavenging activities," Food Chemistry, vol. 114, no. 2, pp. 499–504, 2009.
Y.-J. Zhang, T. Abe, T. Tanaka, C.-R. Yang, and I. Kouno, “Phyl-

M.-T. Lin, S.-S. Lee, and K. C. S. C. Chen, “Polar constitu-

tents of Phyllanthus sellowianus,” Fitoterapia, vol. 64, no. 6, pp. 556–556, 1993.

J. S. Londhe, T. P. A. Devasagayam, L. Y. Foo, P. Shastry, and R. Gambari, M. Borgatti, I. Lampronti et al., “Corilagin is a

C.-M. Yang, H.-Y. Cheng, T.-C. Lin, L.-C. Chiang, and C.-C. Lin, “The in vitro activity of geraniin and 1,3,4,6-tetra-O-
galloyl-β-D-glucose isolated from Phyllanthus amarus against herpes simplex virus type 1 and type 2 infection,” Journal of Ethnopharmacology, vol. 110, no. 3, pp. 555–558, 2007.

J. S. Londhe, T. P. A. Devasagayam, L. Y. Foo, and S. S. Ghaskadbi, “Antioxidant activity of some polyphenol constituents of the medicinal plant Phyllanthus amarus Linn,” Redox Report, vol. 13, no. 5, pp. 199–207, 2008.

L. Y. Foo, “Amarin, a di-dehydroxyhexahydroxyphenoyl hydro-

lysable tannin from Phyllanthus amarus,” Phytochemistry, vol. 33, no. 2, pp. 487–491, 1993.

J. S. Londhe, T. P. A. Devasagayam, L. Y. Foo, P. Shastry, and S. S. Ghaskadbi, “Geraniin and amarin, ellagitannins from Phyllanthus amarus, protect liver cells against ethanol induced cytotoxicity,” Fitoterapia, vol. 83, no. 8, pp. 1562–1568, 2012.

J. S. Londhe, T. P. A. Devasagayam, L. Y. Foo, and S. S. Ghaskadbi, “Radioprotective properties of polyphenols from Phyllanthus amarus Linn,” Journal of Radiation Research, vol. 50, no. 4, pp. 303–309, 2009.

L. Yeap Foo, “Amarinic acid and related ellagitannins from Phyllanthus amarus,” Phytochemistry, vol. 39, no. 1, pp. 217–224, 1995.

L. Y. Foo, “Amarulone, a novel cyclic hydrolysable tannin from Phyllanthus amarus,” Natural Product Letters, vol. 3, no. 1, pp. 45–52, 1993.

Y.-J. Zhang, T. Abe, T. Tanaka, C.-R. Yang, and I. Kouno, “Phyllan-

emblinins A-F, new ellagitannins from Phyllanthus emblica,” Journal of Natural Products, vol. 64, no. 12, pp. 1527–1532, 2001.

W. Luo, L. Wen, M. Zhao et al., “Structural identification of isomalliottisin and other phenolics in Phyllanthus emblica L. fruit hull,” Food Chemistry, vol. 132, no. 3, pp. 1527–1533, 2012.

M.-T. Lin, S.-S. Lee, and K. C. S. C. Chen Liu, “Polar constituents from Phyllanthus myrtifolius,” Chinese Pharmaceutical Journal, vol. 50, no. 6, pp. 327–336, 1998.

A. Kumaran and R. J. Karunakaran, “Nitric oxide radical scav-

enging active components from Phyllanthus emblica L.,” Plant Foods for Human Nutrition, vol. 61, no. 1, pp. 1–5, 2006.

R. Gambari, M. Borgatti, I. Lampronti et al., “Corilagin is a potent inhibitor of NF-κB activity and downregulates TNF-α induced expression of IL-8 gene in cyctic fibrosis IB-1 cells,” International Immunopharmacology, vol. 13, no. 3, pp. 308–315, 2012.
Evidence-Based Complementary and Alternative Medicine

[241] P. Pechtarnee, N. Bunyapraphatsara, G. A. Cordell et al., "X-ray crystal and molecular structure of nirurine, a novel alkaloid related to the secuminagla alkaloid skeleton, from Phyllanthus niruri (Euphorbiaceae)," Journal of the Chemical Society, Perkin Transactions, vol. 1, no. 9, pp. 1551–1556, 1986.

[242] Babady-Bila, T. E. Gedris, and W. Herz, "Niruroidine, a nor-secuminagla-type alkaloid from Phyllanthus nirurioides," Phytochemistry, vol. 41, no. 5, pp. 1441–1443, 1996.

[243] I. Cesari, P. Grisoli, M. Paolillo, C. Milanese, G. Massolini, and G. Brusotti, "Isolation and characterization of the alkaloid Nitidine responsible for the traditional use of Phyllanthus müellerianus (Kuntze) Excell stem bark against bacterial infections," Journal of Pharmaceutical and Biomedical Analysis, vol. 105, pp. 115–120, 2015.

[244] S. Sahni, S. Maurya, U. P. Singh, A. K. Singh, V. P. Singh, and V. B. Pandey, "Antifungal activity of nor-secuminagla against some Phytopathogenic fungi," Mycobiology, vol. 33, no. 2, pp. 97–103, 2005.

[245] R. S. Negi and T. M. Fakhir, "Simplexine (14-hydroxy-4-methoxy-13,14-dihydroxysecuminagla): an alkaloid from Phyllanthus simplex," Phytochemistry, vol. 27, no. 9, pp. 3027–3028, 1988.

[246] Z. Horii, T. Imanishi, M. Yamauchi, M. Hanaoka, J. Parello, and W.-X. Wei and Y.-J. Pan, "The crystal structure of one natural compound cyclo-(1,10-docandiamino-11,20-docanedioic)amide (1,12-diazacyclodocosane-2,11-dione)," Bulletin de la Société Chimique de France, vol. 4, pp. 898–910, 1963.

[247] W.-X. Wei and Y.-J. Pan, "Chemical and Pharmaceutical Bulletin, vol. 1, no. 3, pp. 511–514, 1987.

[248] J.-H. S. Pang, S.-T. Huang, C.-Y. Wang et al., "Ellagic acid, the active compound of Phyllanthus niruri, exerts in vivo anti-angiogenic effect and inhibits MMP-2 activity," Evidence-Based Complementary and Alternative Medicine, vol. 2011, Article ID 251035, 10 pages, 2011.

[249] M. Shimizu, S. Horie, S. Terashima et al., "Studies on aldose reductase inhibitors from natural products. II. Active components of a Paraguayan crude drug "Para-parai mí," Phyllanthus niruri," Chemical & Pharmaceutical Bulletin, vol. 37, no. 9, pp. 2531–2532, 1989.

[250] X.-F. Niu, L. C. He, T. Fan, and Y. Li, "Protecting effect of brevifolin and 8,9-single-epoxy brevifolin of Phyllanthus simplex on rat liver injury," Zhongguo Zhongyao Zazhi, vol. 31, no. 18, pp. 1529–1532, 2006.

[251] N. Paulino, M. G. Pizollatti, R. A. Yunes, T. B. Creccynski-Pasa, and J. B. Calixto, "The mechanisms underlying the relaxant effect of methyl and ethyl gallates in the guinea pig trachea in vitro: contribution of potassium channels," Naunyn-Schmiedeberg's Archives of Pharmacology, vol. 360, no. 3, pp. 331–336, 1999.

[252] S. Bhattacharyya, S. Chatterjee, A. Bauri et al., "Immunopharmacological basis of the healing of indomethacin-induced gastric mucosal damage in rats by the constituents of Phyllanthus emblica," Phytochemistry, vol. 93, no. 1, pp. 47–53, 2007.

[253] S. Maity, N. Nag, S. Chatterjee, S. Adhikari, and S. Mazumder, "Bilirubin clearance and antioxidant activities of ethanol extract of Phyllanthus amarus root in phenylhydrazine-induced neonatal jaundice in mice," Journal of Physiology and Biochemistry, vol. 69, no. 3, pp. 467–476, 2013.

[254] A. R. Santos, R. O. De Campos, O. G. Miguel, V. Cechinel-Filho, R. A. Yunes, and J. B. Calixto, "The involvement of K+ channels and Glu/o protein in the antinociceptive action of the gallic acid ethyl ester," European Journal of Pharmacology, vol. 379, no. 1, pp. 7–17, 1999.

[255] T. Iizuka, H. Moriyama, and M. Nagai, "vasorelaxant effects of methyl brevifolin-carboxylate from the leaves of Phyllanthus niruri," Biological and Pharmaceutical Bulletin, vol. 29, no. 1, pp. 177–179, 2006.

[256] T. Iizuka, M. Nagai, A. Taniguchi, H. Moriyama, and K. Hoshi, "Inhibitory effects of methyl brevifolin-carboxylate isolated from Phyllanthus niruri L. on platelet aggregation," Biological and Pharmaceutical Bulletin, vol. 30, no. 2, pp. 382–384, 2007.
[269] Y. Zhorig, C. X. Zuo, F. Li et al., "Studies on chemical constituents of Phyllanthus urinaria L. and its antiviral activity against hepatitis B virus," Zhongguo Zhongyao Zazhi, vol. 23, no. 6, pp. 363–364, 1998.

[270] G. She, R. Cheng, L. Sha et al., "A novel phenolic compound from Phyllanthus emblica," Natural Product Communications, vol. 8, no. 4, pp. 461–462, 2013.

[271] L.-Z. Zhang, Y.-J. Guo, G.-Z. Tu, F. Miao, and W.-B. Guo, "Isolation and identification of a novel polyphenolic compound from Phyllanthus urinaria L.," Zhongguo Zhongyao Zazhi, vol. 25, no. 12, pp. 725–725, 2000.

[272] M. T. H. Khan, I. Lampronti, D. Martello et al., "Identification of pyrogallol as an antiproliferative compound present in extracts from the medicinal plant Emblica offficinalis: effects on in vitro cell growth of human tumor cell lines," International Journal of Oncology, vol. 21, no. 1, pp. 187–192, 2002.

[273] E. Ajaiyeoba and D. Kingston, "Cytotoxicity evaluation and isolation of a chroman derivative from Phyllanthus amarus aerial part extract," Pharmaceutical Biology, vol. 44, no. 9, pp. 668–671, 2006.

[274] M. A. Quader, M. Khatun, and M. Moshuzzaman, "Isolation of 4-hydroxyesamin and ent-norsericinone from Phyllanthus niruri and their chemotaxonomic significance," Journal of Bangladesh Academy of Sciences, vol. 18, no. 2, pp. 229–234, 1994.

[275] R. M. Kuster, W. B. Mors, and H. Wagner, "Cyclohexenyl butenolides from Phyllanthus klotzschianus," Biochemical Systematics and Ecology, vol. 25, no. 7, p. 679, 1997.

[276] Y. L. Huang, Phytochemical pharmacological studies on Phyllanthus multiflorus, Phyllanthus tenellus, and Phyllanthus virgatus [Ph.D. thesis], Taipei Medical College, Taipei, Taiwan, 1999.

[277] R. Soman and P. P. Pillay, "Isolation of mucic acid from the fruits of Emblica officinalis [Phyllanthus emblica]," Current Science, vol. 31, pp. 13–14, 1962.

[278] J.-Q. Zhao, Y.-M. Wang, H.-P. He et al., "Two new highly oxygenated and rearranged limonoids from Phyllanthus cochinensis," Organic Letters, vol. 15, no. 10, pp. 2414–2417, 2013.

[279] M. Ueda, T. Shigemori-Suzuki, and S. Yamamura, "Phyllanthurinolactone, a leaf-closing factor of nysticin plant, Phyllanthus urinaria L.," Tetrahedron Letters, vol. 36, no. 35, pp. 6267–6270, 1995.

[280] H. L. Zhu, W. X. Wei, M. Zhou, D. Yang, X. W. Fan, and J. X. Liu, "Chemical constituents of Phyllanthus niruri L.," Tianran Chanwu Yanjiu Yu Kaifa, vol. 23, no. 2, pp. 401–403, 2011.

[281] E. O. Lima, V. M. F. Morais, S. T. A. Gomes, V. C. Filho, O. G. Miguel, and R. A. Yunes, "Preliminary evaluation of antifungal activity of xanthoxylne," Acta Pharmaceutica Bonaerense, vol. 14, no. 3, pp. 213–216, 1995.

[282] C. Bothiraja, M. B. Shinde, S. Rajalakshmi, and A. P. Pawar, "In vitro anti-HIV-type 1 and antiviral activity of Emblica officinalis," Research Journal of Pharmacy and Technology, vol. 2, no. 3, pp. 556–558, 2011.

[283] O. Hnatyszyn, A. Broussalis, G. Herrera et al., "Argentine plant extracts active against polymerase and ribonuclease H activities of HIV-1 reverse transcriptase," Phytotherapy Research, vol. 13, no. 3, pp. 206–209, 1999.

[284] B. H. Tai, N. D. Nhu, N. X. Nhiem et al., "An evaluation of the RNase H inhibitory effects of Vietnamese medicinal plant extracts and natural compounds," Pharmaceutical Biology, vol. 49, no. 10, pp. 1046–1051, 2011.

[285] Y. S. Ravikumar, U. Ray, M. Nanditha et al., "Inhibition of hepatitis C virus replication by herbal extract: Phyllanthus amarus as potent natural source," Virus Research, vol. 158, no. 1-2, pp. 89–97, 2011.

[286] Á. L. Álvarez, G. del Barrio, V. Kouri, P. A. Martinez, B. Suárez, and F. Parra, "In vitro anti-herpetic activity of an aqueous extract from the plant Phyllanthus orbicularis," Phytomedicine, vol. 16, no. 10, pp. 960–966, 2009.

[287] G. Del Barrio and F. Parra, "Evaluation of the antiviral activity of an aqueous extract from Phyllanthus orbicularis," Journal of Ethnopharmacology, vol. 72, no. 1-2, pp. 317–322, 2000.

[288] K. B. Harikumar, G. Kuttan, and R. Kuttan, "Inhibition of viral carcinogenesis by Phyllanthus amarus," Integrative Cancer Therapies, vol. 8, no. 3, pp. 254–260, 2009.

[289] N. K. Jain, S. Lodhi, A. Jain, A. Nahata, and A. K. Singhai, "Effects of Phyllanthus acidus (L.) Skeels fruit on carbon tetra-chloride-induced acute oxidative damage in livers of rats and mice," Journal of Chinese Integrative Medicine, vol. 9, no. 1, pp. 49–56, 2011.

[290] B. Rajkapoor, Y. Venugopal, J. Anbu, N. Harikrishnan, M. Gobinath, and V. Ravichandran, "Protective effect of Phyllanthus polyphyllus on acetaminophen induced hepatotoxicity in rats," Pakistan Journal of Pharmaceutical Sciences, vol. 21, no. 1, pp. 57–62, 2008.

[291] S. Gopi and O. H. Setty, "Protective effect of Phyllanthus fraternus against bromobenzene induced mitochondrial dysfunction in rat liver mitochondria," Food and Chemical Toxicology, vol. 48, no. 8–9, pp. 2170–2175, 2010.

[292] M. Ferrer, C. Cristófol, A. Sánchez-Lamar, J. L. Fuentes, J. Barbé, and M. Llagostera, "Modulation of rat and human cytochromes P450 involved in PhIP and 4-ABP activation by an aqueous extract of Phyllanthus orbicularis," Journal of Ethnopharmacology, vol. 90, no. 2-3, pp. 273–277, 2004.

[293] J. L. Fuentes, A. E. Alonso, E. Cuévara et al., "Usefulness of the SOS Chromotest in the study of medicinal plants as radioprotectors," International Journal of Radiation Biology, vol. 82, no. 5, pp. 323–329, 2006.

[294] M. Vernhes, M. González-Pumariaga, L. Andrade et al., "Protective effect of a Phyllanthus orbicularis aqueous extract against UVB light in human cells," Pharmaceutical Biology, vol. 51, no. 1, pp. 1–7, 2013.

[295] N. Giribabu, P. V. Rao, K. P. Kumar, S. Muniandy, S. Swapna Rekha, and N. Salleh, "Aqueous extract of Phyllanthus niruri leaves displays in vitro antioxidant activity and prevents the elevation of oxidative stress in the kidney of streptozotocin-induced diabetic male rats," Evidence-Based Complementary and Alternative Medicine, vol. 2014, Article ID 834815, 10 pages, 2014.

[296] S. Kumar, D. Kumar, R. R. Deshmukh, P. D. Lokhande, S. N. More, and V. D. Rangari, "Antidiabetic potential of Phyllanthus reticulatus in alloxan-induced diabetic mice," Fitoterapia, vol. 79, no. 1, pp. 21–23, 2008.

[297] O. Hnatyszyn, J. Miño, G. Ferraro, and C. Acevedo, "The hypoglycemic effect of Phyllanthus zeltovianus fractions in streptozotocin-induced diabetic mice," Phytotherapy Research, vol. 9, no. 6, pp. 556–559, 2002.

[298] A. Hashim, M. Salman Khan, and S. Ahmad, "Alleviation of hyperglycemia and hyperlipidemia by Phyllanthus virgatus forst extract and its partially purified fraction in streptozotocin induced diabetic rats," EXCLI Journal, vol. 13, pp. 809–824, 2014.
[309] M. Ismail, G. Bagalkotkar, S. Iqbal, and H. A. Adamu, “Anticancer properties and phenolic contents of sequentially prepared extracts from different parts of selected medicinal plants indigenous to malaysia,” Molecules, vol. 17, no. 5, pp. 3745–3756, 2012.

[310] S. Kumar, S. Sharma, D. Kumar, K. Kumar, and R. Arya, “Immunostimulant activity of Phyllanthus reticulatus Poir: a useful plant for infectious tropical diseases,” Asian Pacific Journal of Tropical Disease, vol. 4, supplement 1, pp. S491–S495, 2014.

[311] A. R. S. Santos, V. C. Filho, R. Niero et al., “Analgésic effects of callus culture extracts from selected species of Phyllanthus in mice,” Journal of Pharmacy & Pharmacology, vol. 46, no. 9, pp. 755–759, 1994.
[326] G. Brusotti, I. Cesari, G. Gilardoni et al., “Chemical composition and antimicrobial activity of Phyllanthus muellerianus (Kuntze) Excel essential oil,” *Journal of Ethnopharmacology*, vol. 142, no. 3, pp. 657–662, 2012.

[327] E. Goun, G. Cunningham, D. Chu, C. Nguyen, and D. Miles, “Antibacterial and antifungal activity of Indonesian ethnomedical plants,” *Fitoterapia*, vol. 74, no. 6, pp. 592–596, 2003.

[328] M. Sousa, J. Ousingsawat, R. Seitz et al., “An extract from the medicinal plant Phyllanthus acidus and its isolated compounds induce airway chloride secretion: a potential treatment for cystic fibrosis,” *Molecular Pharmacology*, vol. 71, no. 1, pp. 366–376, 2007.

[329] O. Hnatyszyn, J. Miño, S. Gorzalczany et al., “Diuretic activity of an aqueous extract of Phyllanthus sellowianus,” *Phytomedicine*, vol. 6, no. 3, pp. 177–179, 1999.

[330] R. Kuttan and K. B. Harikumar, *Phyllanthus Species: Scientific Evaluation and Medicinal Applications*, CRC Press, 2011.

[331] M. A. Boim, I. P. Heilberg, and N. Schor, “Phyllanthus niruri as a promising alternative treatment for nephrolithiasis,” *International Brazilian Journal of Urology*, vol. 36, no. 6, pp. 657–664, 2010.

[332] Y. A. Cheng, S. D. Wang, and S. S. Dang, “Clinical study of Phyllanthus pill on treating chronic hepatitis B,” *Zhongxiyi Jiehe Gambing Zazhi*, vol. 19, no. 17, pp. 195–197, 2009.

[333] G. A. Asare, P. Addo, K. Bugyei et al., “Acute toxicity studies of aqueous leaf extract of Phyllanthus niruri,” *Interdisciplinary Toxicology*, vol. 4, no. 4, pp. 206–210, 2011.

[334] G. A. Asare, K. Bugyei, A. Sittie et al., “Genotoxicity, cytotoxicity and toxicological evaluation of whole plant extracts of the medicinal plant Phyllanthus niruri (Phyllanthaceae),” *Genetics & Molecular Research*, vol. 11, no. 1, pp. 100–111, 2012.

[335] G. A. Asare, K. Bugyei, I. Fiawoye et al., “Male rat hormone imbalance, testicular changes and toxicity associated with aqueous leaf extract of an antimalarial plant: Phyllanthus niruri,” *Pharmaceutical Biology*, vol. 51, no. 6, pp. 691–699, 2013.

[336] A. Josiah Obaghwarhiewo and N. Ezekiel Uba, “Histological effects of chronic administration of Phyllanthus amarus on the kidney of adult Wistar rat,” *North American Journal of Medical Sciences*, vol. 2, no. 4, pp. 193–195, 2010.

[337] A. A. Bakare, O. O. Oguntolu, L. A. Adedokun et al., “In vivo evaluation of genetic and systemic toxicity of aqueous extracts of Phyllanthus amarus in mice and rats,” *International Journal of Toxicological & Pharmacological Research*, vol. 7, no. 4, pp. 1–9, 2015.

[338] A. R. Chopade and F. Sayyad, “Toxicity studies and evaluation of Phyllanthus amarus and Phyllanthus fraternus extracts on the central nervous system and musculoskeletal function,” *International Journal of Chemical and Pharmaceutical Sciences*, vol. 2, no. 3, pp. 1333–1338, 2013.

[339] S. K. Singh and V. Prakash, “Toxicity assessment of Oxalis corniculata and phyllanthus fraternus plants,” *International Journal of Pharmacy & Pharmaceutical Sciences*, vol. 6, no. 4, pp. 388–392, 2014.

[340] L. R. Fukumoto and G. Mazza, “Assessing antioxidant and pro-oxidant activities of phenolic compounds,” *Journal of Agricultural & Food Chemistry*, vol. 48, no. 8, pp. 3597–3604, 2000.