

Traditional Indian Medicine

A comprehensive review on *Polyalthia longifolia*

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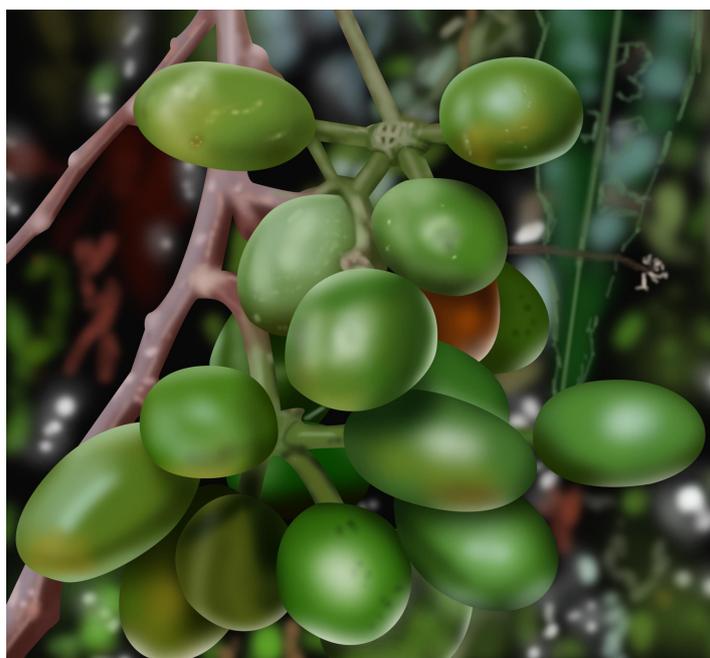
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Highlights

This review reveals detailed information about herbal plant *Polyalthia longifolia*, including the propagation, synonyms, vernaculars, varieties of plant, medicinal significance, ecology and distribution, botanical and ethnobotanical description, phytochemical constituents, and pharmacological activity of the plant.

Tradition

The first recorded report of the use of *Polyalthia longifolia* performed by Troup RS and Chopra RN stated *Polyalthia longifolia* (*P. longifolia*) as a remedy for the treatment of gonorrhea and snake bites and scorpion stings. The aqueous extract of the bark of the plant reduces blood pressure and heart rate. In addition, the bark can be used as a febrifuge. In India it is well known as folk medicine in literatures. Such plants are used in the treatment of septic infections, hepatomegaly, hepatosplenomegaly, coughing, diarrhea, and cancer. It possesses good hyperglycemic, antimicrobial, antioxidant, analgesic, and antitumor activities.



Abstract

Herbal plants act as a significant source for discovering new compounds with potential therapeutic activities. *Polyalthia longifolia*, which is commonly known as an Indian mast tree, has various pharmacological properties, such as an anticancer, ulcer protective, hypoglycemic, hypotensive, a corrosion inhibitor, a bio-adsorbent, and few more. Moreover, it is known as false ashoka owing to its close resemblance with *Saraca indica* (ashoka tree). Various compounds have been reported from the extract of some parts of the plant, such as leaves, bark, root, and seeds. These extracts possess an ability to treat a number of human ailments, such as fever, ulcer, skin diseases, helminthiasis, and cardiac problems. Studies performed on the leave extract shows evidence that some compounds cause cell death in various cancer cell lines. The plant also has some biological applications, such as antibacterial, antiviral, and antimicrobial, which makes it clinically significant and useful. This review is an effort to explore and gather plant information in an organized manner. It reveals detailed information about the propagation, synonyms, vernaculars, varieties of plant, medicinal significance, ecology and distribution, botanical and ethnobotanical description, phytochemical constituents, and pharmacological activity of the plant.

Keywords: *Polyalthia longifolia*, Ecology and distribution, Propagation, Botanical description, Phytochemistry, Pharmacology

Competing interests:

The authors declare no conflicts of interest.

Abbreviations:

P. Longifolia, *Polyalthia longifolia*; *C. albicans*, *Candida albicans*; *E. coli*, *Escherichia coli*; *S. aureus*, *Staphylococcus aureus*.

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Background

India has a 5,000-year history of using medicinal plants in the indigenous system of medicine: Ayurveda, Unani, Siddha, homeopathy, and naturopathy [1]. Medicinal plants have a huge demand not only in developing but also in developed countries owing to their safety, effectiveness, and easy availability. These aspects make medicinal plants as a primary choice for the day-to-day practice of a traditional medical practitioner [2]. The genus *Polyalthia* (Annonaceae) consists of approximately 120 species, from which only 14 are native in India [3]. *Polyalthia* is a Greek word, which means “many cure”, and *longifolia* is a Latin word, which refers to the length of its leaves. The plant mainly belongs to the hot areas of India. The first recorded report of the plantwood use performed by Troup RS [4] and Chopra RN stated *Polyalthia longifolia* (*P. longifolia*) as a remedy for the treatment of gonorrhoea and snake bites and scorpion stings [5]. The aqueous extract of the bark of the plant reduces blood pressure and heart rate. In addition, the bark can be used as a febrifuge, as reported by Chopra RN [5].

In India, traditionally, it is used as a remedy for fever, gonorrhoea, ulcer, skin diseases, and helminthiasis. It possesses good hyperglycemic, antimicrobial, antioxidant, analgesic, and antitumor activities [6]. *P. longifolia* is an evergreen tree that reduces the severity of noise pollution [7]. The mast tree belongs to the family Annonaceae (Table 1), which is also known as the custard apple family. Plants that belong to the Annonaceae family are well known as folk medicine in literatures. Such plants are used in the treatment of septic infections, hepatomegaly, hepatosplenomegaly, coughing, diarrhea, and cancer. It is the tree of choice for landscape designing owing to the formation of excellent contrast of new golden and coppery brown leaves over old dark green leaves [8]. *P. longifolia* is also known as the Buddha tree. It consists of a straight and light-weight trunk. Earlier, it was used in the preparation of masts for sailing ships; therefore, it is called as the mast tree. It is mostly used for the manufacturing of small articles, such as pencil boxes [9]. The stem bark of the plant is frequently used as an adulterant or substitute for the *Saraca indica* bark [10]. *P. longifolia* has a good adsorbent property toward metals. Such action makes the plant useful for industrial wastewater and effluent management [11]. Furthermore, the plant exhibits a good ability to inhibit corrosion [12].

This comprehensive review aims to reveal the detailed information about the propagation, synonyms, vernaculars, varieties of plant, medicinal significance, ecology and distribution, botanical and ethnobotanical description, phytochemical constituents, and pharmacological activity of *P. longifolia*.

Table 1 Current taxonomy of *Polyalthia longifolia*

Taxon: <i>Polyalthia longifolia</i>
Kingdom: Plantae
Clade: Tracheophytes
Clade: Angiosperms
Clade: Magnoliids
Order: Magnoliales
Family: Annonaceae
Genus: <i>Polyalthia</i>
Species: <i>Polyalthia longifolia</i>
Binomial name: <i>Polyalthia longifolia</i> (Sonn.)
Data from: Wikipedia. <i>Monoon longifolium</i> . https://en.wikipedia.org/wiki/Polyalthia_longifolia . Access -ed July 05 2020 [7].

Ecology and distribution

History of cultivation

P. longifolia is native of India and Sri Lanka and has been spread across the Indian subcontinent and adjacent areas. The mast tree is a tall, evergreen, and symmetrical tree with a bunch of dark green leaves. It is mostly grown for garden designing in various tropical countries [9]. In India, Sri Lanka, and Southeast Asia, the plant is mainly cultivated as a street tree [13]. In Southern Taiwan, the plant is cultivated for various purposes [14].

Geographic distribution

The native geographic distribution includes India Andaman & Nicobar Islands, Andhra Pradesh, West Bengal, Assam, Arunachal Pradesh, Bihar, Punjab, Rajasthan, Maharashtra, Manipur, Mizoram, Tamil Nadu, Gujarat, Jharkhand, Karnataka, Uttar Pradesh, Delhi, Goa, Kerala, Madhya Pradesh [15], and Sri Lanka.

The exotic geographic distribution includes Bhutan, China [15], Pakistan and Nigeria [16, 17], Philippines [18], Malaysia, East Africa, Madagascar, Northern Australia and Melanesia [19], Bangladesh [20], and the Caribbean Islands of Trinidad and Tobago [9].

Natural habitat

P. longifolia needs tropical and subtropical climate, and in India, it grows up to an altitude of 1,500 m [1]. It naturally grows in sub-humid to humid areas with an annual rainfall of 800–3,800 mm and can sustain up to 8 months during dry seasons. It requires frost-free areas, with a temperature range of 16–35 °C for growth. *P. longifolia* requires rich, free-draining clay-loam, loam, sandy-loam, and loamy-sand soils with a pH of approximately 5.5–7.5 [13]. *P. longifolia* has the ability to tolerate drought conditions and survive outside during winter in an estimated 30–40 F temperature. Full sun exposure is essential for plant growth [21].

Propagation

Propagation methods

P. longifolia plant is mainly propagated by seeds and takes 2–3 weeks for germination. The tree can be grown by using various techniques, such as softwood cutting and air layering [21]. After the collection of ripe fruits, it is kept in an open environment for softening. The softening allows the easy removal of seeds and then it is washed to remove earthy matter and subjected for air drying under a shade. Young seedlings are kept for approximately 1 year in nurseries and then planted out [13].

Description of plant

Synonym

Various synonyms of *P. longifolia* plant are *Guatteria longifolia* (Sonn.) Wall., *Unona longifolia* (Sonn.) Dunal, *Uvaria altissima* pennant Nom. Illeg., and *Uvaria longifolia* (Sonn) [7].

Vernaculars

P. longifolia is known by different names in various regions of India, such as acokam, arana, ashoka, asoka, assoti, celai, celokatam, chorani, kacupam, kambadamara, nara maamidi, naranamidi, nettilingam, pundi, pungu, ravadam, suvattai, ubbina mara, ulkatah, and vanamutti [22]. In the drier regions of India, it is locally known as asaphala [1]. In English, it is known as false ashok, asoka tree, mast tree, cemetery tree, Indian fir, Indian willow, telegraph pole tree, and weeping polyalthia [22]. In Sanskrit, it is known as putrajiva. In Assamese, it is known as unboi, umboi, and debdaru. In addition, in Marathi, it is known as devdar. In the South regions of India, it is known by various names, such as asokamu in Telegu, asogam in Tamil, putranjiva, ashoka mara in Kannada, and chorunna and ashokam in Malayalam [15]. In Nigeria, it is locally known as the masquerade tree [16]. *P. longifolia* is locally known as ultha ashok in the drier regions of Sri Lanka [23].

Varieties of plant

The plant is present in 2 varieties namely *P. longifolia* var. *pendula* and *P. longifolia* var. *angustifolia*. *P. longifolia* var. *pendula* is easily noticeable and therefore attracts a lot of attention. This variety shows features like a slim, straight trunk, and shorter branches. The branches are inclined in a downward direction, which gives a narrow columnar shape to the tree. *P. longifolia* var. *angustifolia* shows a gray and smooth bark. The branches present in a more widespread manner, which forms a pyramidal crown shape to the tree [13].

Botanical description of the plant

The *P. longifolia* is also known as the Buddha tree. The mast tree is evergreen, erect, handsome, pyramid-like

with a straight trunk, conical crown, and slender drooping branches. The stem is straight and undivided and grows up to 12 m or more. The branches are 1–2 m in length and are slender and short. Moreover, the branches are glabrous and pendulous (hanging down loosely) [15, 17]. Approximately 1-year-old branches bear axillar inflorescence [22].

The leaves consist of wavy margin, present in dense, cluster form. They are bronze, lime green, or dark green in color according to the age of the plant [13]. Either side of midrib contains approximately 25–30 lateral veins. Leaves dimensions are ranging from 7.5 to 23 cm in length and 1.5 to 3.8 cm in width. It is glabrous on the upper surface, whereas paler glaucous on the lower surface. Its features are mildly aromatic, narrowly lanceolate, glabrous, shining, exstipulate, distichous, and alternate. The mast tree leaves have a short petiolate, which is approximately 6 mm long. Its margin is undulate, leathery, or subcoriaceous and pinnately veined. The leaves have a fine acuminate apex [15, 17]. *P. longifolia* is a larval food plant for tailed jay and kite swallowtail butterflies [7].

Bloom is bisexual and pale green in color. The plant mainly blooms in mid-, late, or early summer (during spring in a period approximately 2–3 weeks).

The flowers are small in size and star shaped. They grow from the branches and consist of calyx with 3 ovate-triangular sepals and corolla with 6 petals. The sepals are short, triangular, broad, 2–3 mm long, with flattened and matted external hairs (tomentose), and the tips are reflexed. The stamens are 1 mm long. The gynoecium consists of 20–25 free monovular carpels, which are 1–2 mm long [22]. The flowers remain on the plant for a short period and are not very much noticeable due to its color [7].

The fruits are 1.8–2 cm long and contain pale brown, ovoid seeds, with one seed per fruit. It has a 1.3-cm long, glabrous, and short stalk [17, 22]. The fruits are egg shaped and present in the form of clusters of 10–20 fruits. Initially, they are green and when ripen, become purple or black in color. The ripe fruits attract birds, butterflies, bats, and flying foxes. They feed on it and discard the seeds in the soil [8, 16].

P. longifolia has a trunk covered by gray bark. It consists of a small-diameter trunk, which produces a yellowish to gray white wood. The average weight of the wood is approximately 590 kg per cubic meter (37 lbs per cubic ft). It naturally has a less ability to resist rot and decay and used in the manufacturing of ber. The tree has a straight columnar growth with a huge number of leaves; therefore, it is used as a wind blocker or visual divider in open spaces and as a hedge tree and first choice in landscape designing [8, 13].

Ethnobotanical description

In the Indian traditional system of medicine, *P. longifolia* is used to treat various disorders, such as hypertension, diabetes, fever, skin diseases, pyrexia,

bleeding disorders, and helminthiasis. The plant extracts acts as an effective remedy for various ailments, such as rheumatism, scorpion sting, menorrhagia, and various digestive system complications [3].

Different uses of the plant in various regions of India

South Indian region: different parts of the plant have been used to treat fever, gonorrhea, uterus ailment, and leukorrhea. Decoction of the bark provides beneficial effects for the treatment of mouth ulcers [1]. Its leaves are used to treat fever, gonorrhea, uterus ailments, mouth ulcers, heart problems, and others in Vellore, Tamil Nadu, India [24]. Its stem bark is used as a febrifuge by the tribe of Visakhapatnam and Andhra Pradesh [25]. The fresh stem bark juice is used to treat indigestion by local communities of Uthiramerur of Tamil Nadu, India [26]. In the Manchale area of the Shimoga district, Karnataka, abortion in pregnant women is prevented by the stem bark [27]. In Eastern Ghats, the paste of the stem bark of *P. longifolia* with root bark of *Mimosa intsia* L. and leaves of *Tridax procumbens* are applied as a bandage over bone fractures. Similarly, the mixture of the stem bark of *P. longifolia* with seeds of *Sesamum indicum* and *Piper nigrum* are also applied on fractured areas [28].

West Indian region: dried stem bark with butter is used to treat gonorrhea by the Adeevasee communities of Danta, Gujarat [29]. The tribe of the Bankura district, West Bengal, India uses the plant stem bark in some disorders, like diabetes and hypertension [30].

In the central Indian region, the stem bark is used to treat malignant tumors by the tribal people of Khargone, Madhya Pradesh [31].

In Bangladesh, traditional medicinal practitioners are known as Kavirajes or Vaidyas. The combination of plants used by the Kavirajes of Bheramara area is used for the treatment of complicated or serious ailments. To treat snake bites, the roots of *P. longifolia* are combined with the roots of *Morinda citrifolia* and rhizomes of *Curcuma longa* [20].

P. longifolia leaves extract shows an enormous spectrum of activity. Its extract had undergone several studies and proved to possess various activities, such as radioprotective, antityrosinase, protective, antifungal, antibacterial, antiulcer, antihyperglycemic, anticancer, antioxidant, and hepatoprotective activities [32]. The solvent extracts of the leaves possess inhibitory activities against human pathogenic yeasts, such as *Cryptococcus neoformans* and *Candida albicans* (*C. albicans*) (isolated from human immunodeficiency virus patients), and molds, such as *Aspergillus candidus* and *Trichosporan beigelli* [33]. The alcoholic extract of the leaves has inhibitory effects against *Fusarium solani* isolated from the rotted rhizomes of ginger [34].

The aqueous extract of the leaves has good

antifungal activities against various species of *Aspergillus*, such as the aflatoxin-producing *Aspergillus parasiticus*. It also shows inhibitory effects on seed-born fungi isolated from green gram. A significant antibacterial activity is exhibited by the methanol extract of the leaves and green berries. The mycelial growth of *Colletotrichum capsica* and drug-resistant gram-positive and gram-negative bacteria from urinary tract infections is inhibited by the extracts of the leaves, ripe pericarp, and unripe pericarp [31].

The hexane extract of the seeds and the extract of the bark show promising antibacterial and antifungal activities [35].

Phytochemical study

Numerous compounds have been reported from different parts of the plant, mainly from leaves, stem bark, seeds, fruits, and roots. The structures of the chemical constituents extracted from the plant are shown in Table 2.

Chemical constituents extracted from the leaves

Successful identification and isolation of clerodane diterpenoids, namely 16(R and S)-hydroxy-cleroda-3,13(14)Z-dien-15,16-olide-2-one, (4→2)-abeo-16(R and S)-hydroxy-cleroda-2,13(14)Z-dien-15,16-olide-3-al, 3β,16α-dihydroxy-cleroda-4(18),13(14)Z-dien-15,16-olide, methyl-16-oxo-cleroda-3,13(14)E-dien-15-oate, 2-oxo-kolavenic acid, 16-oxo-cleroda-3,13(14)E-dien-15-oic acid, and 16(R and S)-hydroxy-cleroda-3,13(14)Z-dien-15,16-olide were performed from the methanolic extract of leaves and berries of the plant. These diterpenes were further subjected for an antimicrobial activity analysis [36]. Afolabi et al. isolated tetranorditerpene as 1-naphthalene acetic-7-oxo-1,2,3,4,4a,7,8,8a-octahydro-1,2,4a,5-tetramethyl acid from *P. longifolia* leaves. These terpenoids were evaluated for cytotoxicity toward human leukemia HL-60 cells [37].

P. longifolia leaves when extracted with ethyl acetate, indicated the presence of carbohydrates, flavonoids, steroids, glycosides, and tannins [1]. A diterpene, called 16α-hydroxycleroda-3,13(14)Z-dien-15,16-olide, had been extracted from the leaves of the plant [38]. This diterpene had shown various pharmacological activity evidence, which mainly included antimicrobial [39], antileishmanial [40], antifeedant [41], antifungal [38], cytotoxic [42], and antiulcerative properties [43]. Three aporphine N-oxide alkaloids, (+)-O-methyl bulbocapnine-β-N-oxide, (+)-O-methyl bulbocapnine-α-N-oxide, (+)-N-methyl nandigerine-β-N-oxide, and a azaflurene alkaloid, polylongine (5-hydroxy-6-methoxy-1-methyl-4-azafluoren-9-ol) had been isolated from the methanolic extract of the leaves of *P. longifolia* [44]. Sashidhara et al. isolated a cytotoxic cycloartane

Table 2 Structure of chemical constituents

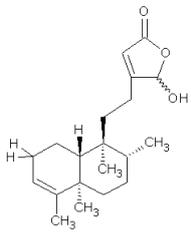
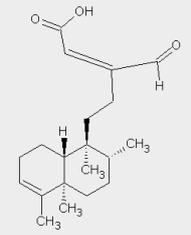
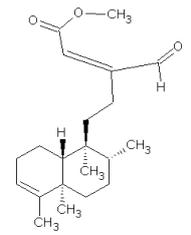
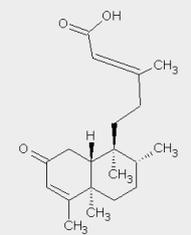
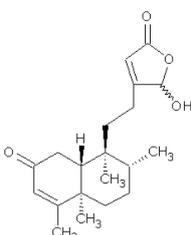
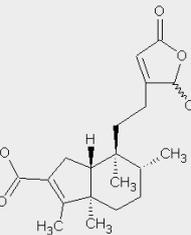
Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
1	16(R and S)-hydroxy-cleroda-3,13(14)Z-dien-15,16-olide	Leaves and berries		Terpenoid	[36]
2	16-oxo-cleroda-3,13(14)E-dien-15-oic acid	Leaves and berries		Terpenoid	[36]
3	Methyl-16-oxo-cleroda-3,13(14)E-dien-15-oate	Leaves and berries		Terpenoid	[36]
4	2-oxo-kolavenic acid	Leaves and berries		Terpenoid	[36]
5	16(R and S)-hydroxy-cleroda-3,13(14)Z-dien-15,16-olide-2-one	Leaves and berries		Terpenoid	[36]
6	(4→2)-abeo-16(R and S)-hydroxy-cleroda-2,13(14)Z-dien-15,16-olide-3-al	Leaves and berries		Terpenoid	[36]

Table 2 Structure of chemical constituents (Continued)

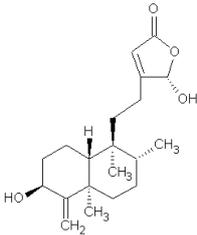
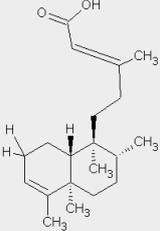
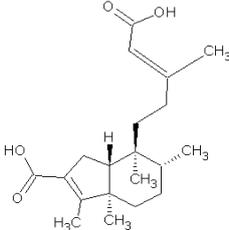
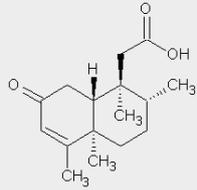
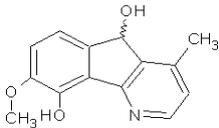
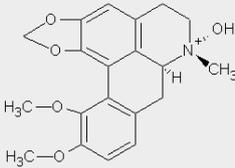
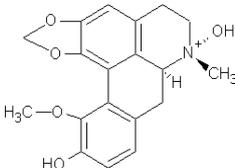
Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
7	3 β ,16 α -dihydroxy-cleroda-4(18),13(14)Z-dien-15,16-olide	Leaves and berries		Terpenoid	[36]
8	Kolavenic acid	Root wood		Terpenoid	[36]
9	Solidagonal acid	Root wood		Terpenoid	[36]
10	1-naphthalene acetic-7-oxo-1,2,3,4,4a,7,8,8a-octahydro-1,2,4a,5-tetramethyl acid	Leaves		Terpenoid	[37]
11	Polylongine (5-hydroxy-6-methoxy-1-methyl-4-azafluoren-9-ol)	Leaves		Alkaloid	[44]
12	(+)-O-methyl bulbocapnine- α -N-oxide	Leaves		Alkaloid	[44]
13	(+)-N-methyl nandigerine- β -N-oxide	Leaves		Alkaloid	[44]

Table 2 Structure of chemical constituents (Continued)

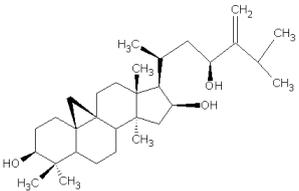
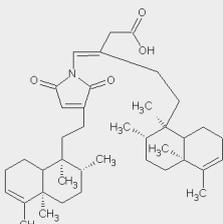
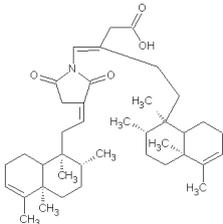
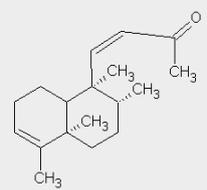
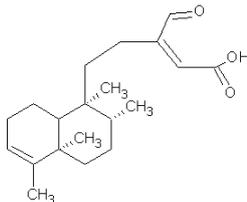
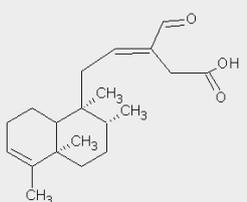
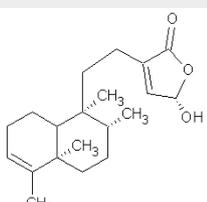
Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
14	Longitriol	Leaves		Terpenoid	[45]
15	Longimide A	Leaves		Terpenoid	[45]
16	Longimide B	Leaves		Terpenoid	[45]
17	(-)-14,15-bisnor-3,11E-kolavadien-13-one	Leaves		Terpenoid	[46]
18	(-)-16-oxocleroda-3,13(14)E-dien-15-oic acid	Leaves		Terpenoid	[46]
19	(-)-3,12E-kolavadien-15-oic acid-16-al	Leaves		Terpenoid	[46]
20	(+)-(4→2)-abeo-16(R/S)-2,13Z-kolavadien-15,16-olide-3-al	Leaves		Terpenoid	[46]

Table 2 Structure of chemical constituents (Continued)

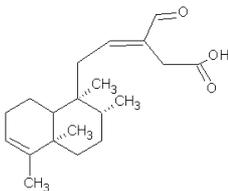
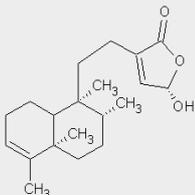
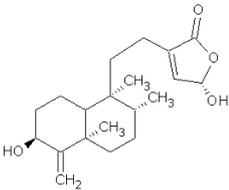
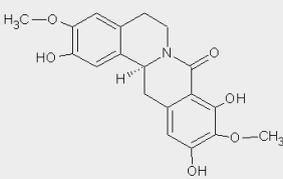
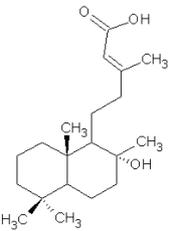
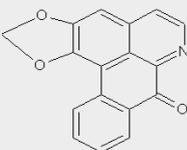
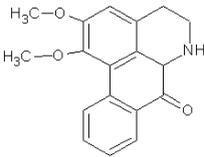
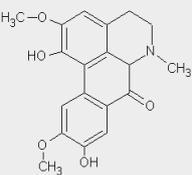
Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
19	(-)-3,12E-kolavadien-15-oic acid-16-al	Leaves		Terpenoid	[46]
20	(+)-(4→2)-abeo-16 (R/S)-2,13Z-kolavadien-15,16-olide-3-al	Leaves		Terpenoid	[46]
21	(-)-3β,16α-dihydroxyclerod a-4(18),13(14)Z-dien-15,16-olide	Leaves		Terpenoid	[46]
22	(-)-8-oxopolyalthiaine	Leaves		Alkaloid	[14]
23	(-)-labd-13E-en-8-ol-15-oic acid	Leaves		Terpenoid	[46]
24	Liriodenine	Leaves		Alkaloid	[46]
25	(-)-anonaine	Leaves		Alkaloid	[46]
26	(+)-isoboldine	Leaves		Alkaloid	[46]

Table 2 Structure of chemical constituents (Continued)

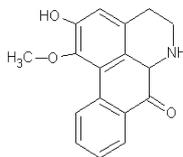
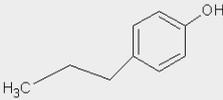
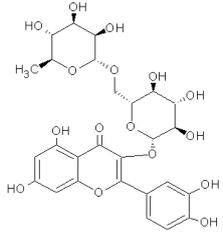
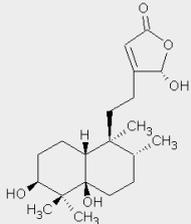
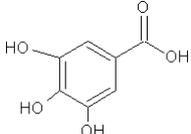
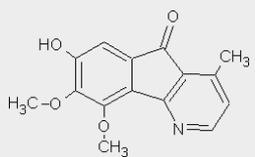
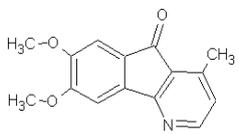
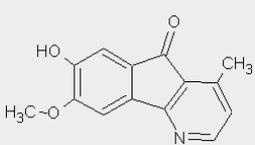
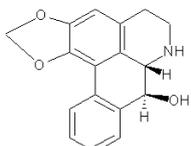
Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
27	(-)-asimilobine	Leaves		Alkaloid	[46]
28	Hordenine	Leaves		Alkaloid	[46]
29	Rutin	Leaves		Flavonoid	[47]
30	3β,5β,16α-trihydroxy halima-13(14)-en-15, 16-olide	Leaves		Terpenoid	[14]
31	Gallic acid	Leaves		Phenolic acid	[4]
32	Darienine	Stem and stem bark		Alkaloid	[54]
33	Polyfothine	Stem and stem bark		Alkaloid	[54]
34	Isooncodine	Stem and stem bark		Alkaloid	[54]
35	Noroliveroline	Stem and stem bark		Alkaloid	[54]

Table 2 Structure of chemical constituents (Continued)

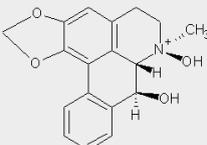
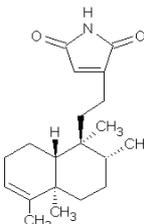
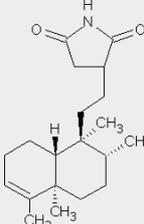
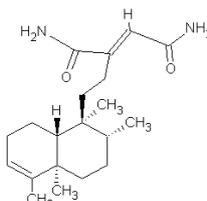
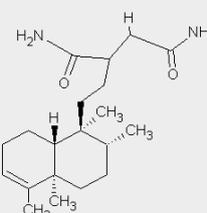
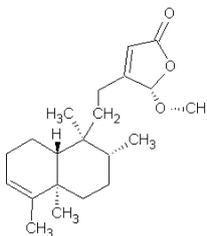
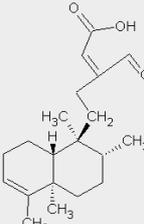
Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
36	Oliveroline- β -N-oxide	Stem bark		Alkaloid	[54]
37	Cleroda-3-ene pyrrole-15,16-dione	Stem bark		Terpenoid	[58]
38	Cleroda-3-ene pyrrolidine-15,16-dione	Stem bark		Terpenoid	[58]
39	Cleroda-3,13(14)E-diene-15,16-diamide	Stem bark		Terpenoid	[58]
40	Cleroda-3-ene-15,16-diamide	Stem bark		Terpenoid	[58]
41	γ -methoxy butenolide	Stem bark		Terpenoid	[60]
42	Ent-halima-5(10),13-dien-16,15-olide	Stem bark		Terpenoid	[59]

Table 2 Structure of chemical constituents (Continued)

Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
43	16-hydroxy-ent-halima-5(10),13-dien-16,15-olide	Stem bark		Terpenoid	[59]
44	16-oxo-ent-halima-5(10),13E-dien-15-oic acid	Stem bark		Terpenoid	[59]
45	Ent-halima-1(10),13E-dien-16,15-olide	Stem bark		Terpenoid	[59]
46	Ent-halima-5(10),13E-dien-16,15-olide	Stem bark		Terpenoid	[59]
47	4 α ,18 β -epoxy-16-hydroxyclerod-13-en-15-oic acid	Stem		Terpenoid	[56]
48	6 α ,16-dihydroxycleroda-4(18),13-dien-15-oic acid	Stem		Terpenoid	[56]
49	6 α ,16-dihydroxycleroda-3,13-dien-15-oic acid	Stem		Terpenoid	[56]

Table 2 Structure of chemical constituents (Continued)

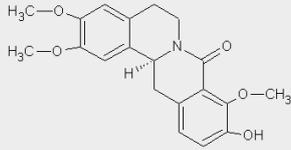
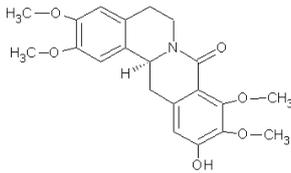
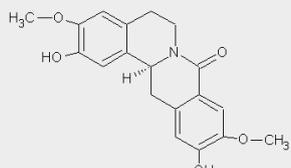
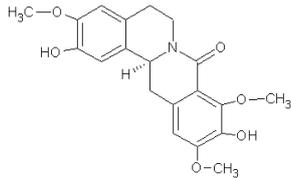
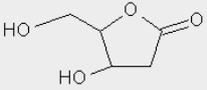
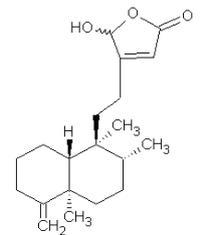
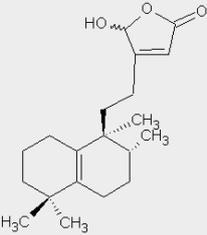
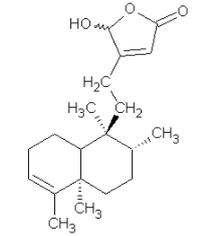
Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
50	(-)-8-oxo-10-hydroxy-2,3,9-trimethoxyberberine	Stem		Alkaloid	[56]
51	(-)-8-oxo-11-hydroxy-2,3,9,10-tetramethoxyberberine	Stem		Alkaloid	[56]
52	(-)-8-oxo-2,11-dihydroxy-3,10-dimethoxyberberine	Stem		Alkaloid	[56]
53	(-)-8-oxo-2,10-dihydroxy-3,9,11-trimethoxyberberine	Stem		Alkaloid	[56]
54	(3S,4R)-3,4,5-trihydroxypentanoic acid-1,4-lactone	Stem		Lactone	[57]
55	16-oxocleroda-4(18),13E-dien-15-oic acid	Stem bark		Terpenoid	[59]
56	Cleroda-4(18),13-dien-16,15-olide	Stem bark		Terpenoid	[59]
57	16-hydroxycleroda-4(18),13-dien-16,15-olide	Stem bark		Terpenoid	[59]

Table 2 Structure of chemical constituents (Continued)

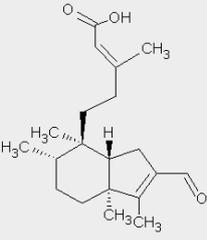
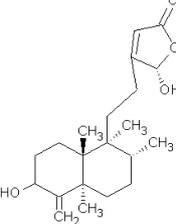
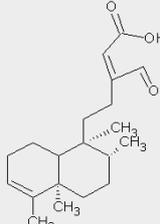
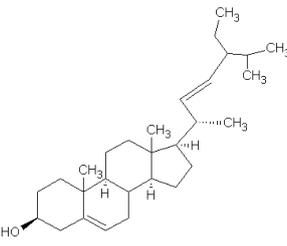
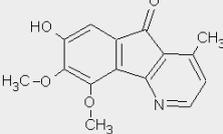
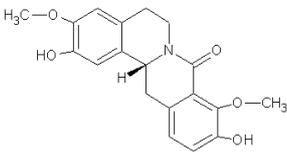
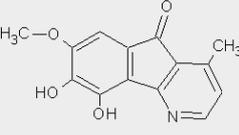
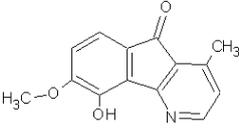
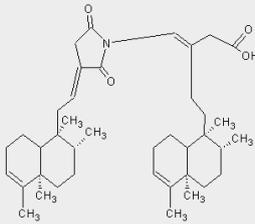
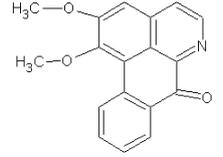
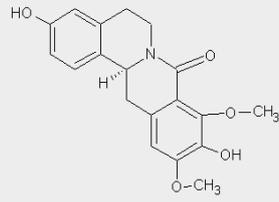
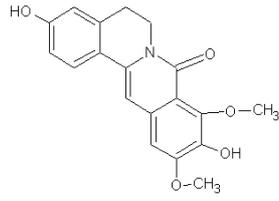
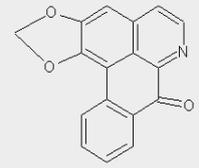
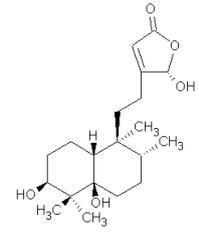
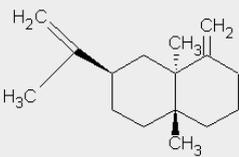
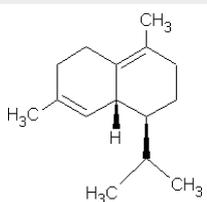
Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
58	Solidagonal acid	Root wood		Terpenoid	[36]
59	3,16-dihydroxycyclo- <i>roda</i> -4(18),13(14) <i>Z</i> -dien-15,16-olide	Stem bark		Terpenoid	[61]
60	16-oxocyclo- <i>roda</i> -3,13 <i>E</i> -dien-15- <i>oic</i> acid	Stem bark		Terpenoid	[61]
61	Beta-stigmasterol	Stem bark		Steroids	[61]
62	Darienine	Stem bark		Alkaloid	[61]
63	Stepholidine	Stem bark		Alkaloid	[61]
64	Penduline	Root		Alkaloid	[62]
65	Isoursuline	Root		Alkaloid	[62]

Table 2 Structure of chemical constituents (Continued)

Sr. No	Name of chemical constituent	Site of extraction	Structure	Class of compound	Serial number of cited literatures
66	Bisclerodane imide	Root bark		Alkaloid	[23]
67	Lysicamine	Root bark		Alkaloid	[23]
68	Pendulamine A	Root		Alkaloid	[62]
69	Pendulamine B	Root		Alkaloid	[62]
70	Liriodenine,	Root bark		Alkaloid	[23]
71	3β,5β,16α-trihydroxy halima-13(14)-en-15, 16-olide	Leaves		Terpenoids	[14]
72	β-selinene	Leaves and stem bark		Terpenoids	[49, 55]
73	δ-cadinene	Leaves and stem bark		Terpenoids	[49, 55]

triterpene longitriol and rare bisclerodane imides, namely longimide A and longimide B, from the ethanolic extract of *P. longifolia* leaves [45].

Seven clerodane diterpenoids, namely (-)-14,15-bisnor-3,11E-kolavadien-13-one, (-)-16-oxocleroda-3,13(14)E-dien-15-oic acid, (-)-3 β ,16 α -dihydroxycleroda-4(18),13(14)Z-dien-15,16-olide, (+)-(4 \rightarrow 2)-abeo-16(R/S)-2,13 Z-kolavadien-15,16-olide-3-al, (-)-3,12E-kolavadien-15-oic acid-16-al, (-)-labd-13 E-en-8-ol-15-oic acid, (-)-16 α -hydroxycleroda-3,13(14)Z-dien-15,16-olide, and 5 alkaloids, namely liriodenine, (-)-anonaine, (+)-isoboldine, (-)-asimilobine and hordenine were isolated from the ethanolic extract of *P. longifolia* leaves [39]. An estimation of rutin in the plant leaves was conducted by Doshi et al. Its amount, as estimated by high-performance liquid chromatography and high-performance thin-layer chromatography, was found to be 11.60% w/w and 4.03% w/v, respectively [46].

A new halimane diterpene, 3 β ,5 β ,16 α -trihydroxy halima-13(14)-en-15,16-olide, and a new oxo-protoberberine alkaloid, (-)-8-oxopolyalthiaine, alongside 20 known compounds were identified and isolated from the methanolic extract of *P. longifolia* var. *pendula* leaves [14]. Heavy metals, including lead (Pb), cadmium (Cd), arsenic (As), and mercury (Hg) [47], were found in the *P. longifolia* leaf extract, and the concentration was well within the suitable daily intake values.

P. longifolia contains sesquiterpene-rich essential oils. An analysis of the leaf oil indicated the presence of approximately 70 compounds, including 11 monoterpenes, 53 sesquiterpenes, 2 acyclic compounds, 3 fatty acids, and 1 diterpene acid. Sesquiterpene hydrocarbons (83.0%) covered a higher part of the volatile oil. The major components were (E)- β -caryophyllene (27.5%), α -zingiberene (11.9%), allo-aromadendrene (14.1%), and α -humulene (8.3%) with α -selinene (2.8%), β -selinene (2.5%), trans- β -bergamotene (1.9%), trans- α -bergamotene (1.7%), α -copaene (1.3%), and δ -cadinene (1.2%).

Monoterpene hydrocarbons (2.6%) included α -pinene (1.6%) and (E)- β -ocimene (0.6%) with camphene, myrcene, and limonene. Oxygenated monoterpenes (0.5%) included linalool, thymol, and α -terpineol. Two oxygenated acyclic non-terpene compounds, namely 2-nonanone and 2-methylnonanal, were detected at trace levels.

Certain stereoisomers like trans- α -bergamotene, (E)- β -farnesene, trans- β -bergamotene, ar-curcumene, γ -muurolene and β -humulene, β -sesquiphellandrene, and δ -cadinene as well as minor sesquiterpene hydrocarbons, namely α -ylangene, isocaryophyllene, γ -cadinene, and calamenene were also present.

In addition, 2.4% of oxygenated sesquiterpenes were detected, which included sesquicineole, palustrol, caryophylla-4(14),8(15)-dien-5 α -ol, caryophyllenol II,

1-epi-cubenol, τ -cadinol, τ -muurolol, cubenol, selin-11-en-4 α -ol, α -cadinol, caryolan-4-ol, β -bisabolol, and α -bisabolol. It also contains bornyl formate, bornyl acetate, geranyl acetate, 4,8- α -epoxycaryophyllane, 4,8- β -epoxycaryophyllane, 5,8-cyclocaryophyllan-4-ol, caryolan-8-ol, 4-formyl-5-nor- β -caryophyllene, 5,11-epoxycadin-1(10)-ene, humulene oxide I, zingiberenol I, muurola-4,10(14)-dien-1 β -ol, zingiberenol II, torreyol, caryophyllenol I, bisabola-2,10-dien-1-ol, trans- β -sesquiphellandrol phytone, oleic acid, linoleic acid, linolenic acid, and kovaleic acid [48]. The *P. longifolia* sample yielded a light yellow color, 0.15%, v/w of volatile oil, calculated on a dry weight basis [49]. In the ethanolic extract of *P. longifolia* leaves, the presence of gallic acid was also reported [6].

Chemical constituents extracted from seeds and fruits

An analysis of the seeds of *P. longifolia* revealed the presence of percentage moisture (5.0 g), crude oil (7.5 g), crude protein (14.0 g), crude fiber (7.3 g), and total carbohydrate (65.3 g) per 100 g sample. The seeds showed the presence of macro- and micronutrients as well as various minerals like potassium, magnesium, calcium, iron, sodium, manganese, copper, zinc, nickel, cobalt, lead, and chromium [16].

Atolani et al. studied the seed oil of the plant obtained by the Soxhlet extraction. Fatty acids in major proportions were oleic acid (30.31%), linoleic acid (19.27%), palmitic acid (15.11%), and little proportions of tricosylic acid (6.10%) and stearic acid (5.56%) had been isolated from the seeds of the *P. longifolia* [50]. Amino acids present in the *P. longifolia* seeds were detected using paper chromatography technique. Results showed the presence of proline, l-glutamic acid, dl-threonine, l-tyrosine, dl-methionine, glycine, dl-isoleucine, l-hydroxy-proline, et al. [51].

Various minerals were reported from powdered ripe and unripe pericarps, namely calcium, potassium, sodium, and magnesium. Some minor elements, such as zinc, manganese, iron, nickel, chromium, lithium, and copper were also reported [52].

Chemical constituents extracted from stems and stem bark

Three azafluorene alkaloids, namely darienine, polyfothine, and isooncodine, and three aporphine alkaloids, namely liriodenine, noroliveroline- β , and oliveroline- β -N-oxide, were isolated from the stems and stem bark of *P. longifolia* [53].

A study of essential oils from the stem bark of *P. longifolia* showed the presence of α -copaene and α -muurolol (8.7%), β -selinene (8.6%), viridiflorene (8.1%), α -guaiene (7.8%), allo-aromadendrene (7.4%), and δ -cadinene (7.0%). However, 2 monoterpenoids, namely α -pinene and camphene, were absent [54].

Clerodane diterpenes were isolated from the

methanolic extract of *P. longifolia* stem, namely 4 α ,18 β -epoxy-16-hydroxyclerod-13-en-15-oic acid, 6 α ,16-dihydroxycleroda-4(18),13-dien-15-oic acid, 6 α ,16-dihydroxycleroda-3,13-dien-15-oic acid, along with 4 new protoberberine alkaloids, such as (-)-8-oxo-10-hydroxy-2,3,9-trimethoxyberberine, (-)-8-oxo-11-hydroxy-2,3,9,10-tetramethoxyberberine, (-)-8-oxo-2,11-dihydroxy-3,10-dimethoxyberberine, and (-)-8-oxo-2,10-dihydroxy-3,9,11-trimethoxyberberine [55].

The ethanol extract of the stems contains an antibacterial lactone, (3S, 4R)-3,4,5-trihydroxypentanoic acid-1,4-lactone [56]. Clerodane diterpenes, namely cleroda-3-ene pyrrole-15,16-dione, cleroda-3-ene pyrrolidine-15,16-dione(4), cleroda-3,13(14)E-diene-15,16-diamide, and cleroda-3-ene-15,16-diamide, were isolated from the stem bark of *P. longifolia*, which had a potential to act against plasmodial species [57].

Clerodone diterpenes, like 16-oxocleroda-4(18),13E-dien-15-oic acid, cleroda-4(18),13-dien-16,15-olide, and 16-hydroxycleroda-4(18),13-dien-16,15-olide and ent-halimane diterpenes, like 16-oxo-ent-halima-5(10),13E-dien-15-oic acid, ent-halima-5(10),13-dien-16,15-olide alongside 16-hydroxy-ent-halima-5(10),13-dien-16,15-olide, 16-oxo-ent-halima-5(10),13E-dien-15-oic acid, ent-halima-l(10),13E-dien-16,15-olide and ent-halima-5(10),13E-dien-16,15-olide, were identified in the hexane extract of the stem bark of the plant [58].

The petroleum ether extract of the *P. longifolia* bark indicated the presence of γ -methoxy butenolide clerodane diterpene [59]. The ethanolic extract of the *P. longifolia* stem bark yielded 3 clerodone diterpenes, namely 16-hydroxy-cleroda-3,13-dien-16,15-olide, 3,16-dihydroxycleroda-4(18),13(14)Z-dien-15,16-olide, and 16-oxocleroda-3,13E-dien-15-oic acid alongside 1 steroid beta-stigmasterol and 2 alkaloids darienine and stapholidine [60].

Chemical constituents extracted from root

The root extract of *P. longifolia* showed the presence of pendulamine A, pendulamine B, penduline with stigmasterol 3-O- β -D-glucoside, allantoin, kolavenic acid, and the azafluorene alkaloid isoursuline [61]. Kolavenic acid, liriodenine, bisclerodane imide with its four olefinic isomers, clerodane diterpene and its four olefinic isomers, and lysicamine were isolated from the defatted extract of the *P. longifolia* root bark [23]. Clerodone diterpenoids, namely kolavenic and solidagonal acid, were extracted from the root wood of the plant [36].

Pharmacological studies

Antiulcer activity

The methanolic extract of *P. longifolia* leaves was evaluated for in vivo ulcer-protective function. The

experiment involved the use of wistar albino rats, in which ulcers were induced by ethanol and ethanol/HCl. Results showed that the extract possessed a good dose-dependent antiulcer activity [62]. The aqueous and ethanolic extracts of the plant leaves showed an ability to reduce total acidity, ulcer index, and gastric content and enhance the pH of gastric pylorus ligation ulcer model [63].

Antimicrobial activity

Gram-positive bacteria, such as *Bacillus megaterium*, and gram-negative bacterial and fungal strains, such as *Proteus mirabilis*, *Candida tropicalis*, and *C. albicans* resp. Were more susceptible to the methanolic extract of the *P. longifolia* leaves [62]. *P. longifolia* showed less activity toward gram-negative bacterial strains [64]. An antibacterial activity against *Escherichia coli* (*E. coli*), *Staphylococcus aureus* (*S. aureus*), *Pseudomonas aeruginosa*, and *Bacillus cereus* microorganisms was exhibited by the ethyl acetate extract of the plant leaves [1]. *P. longifolia* exhibited a marked antibacterial activity against *Klebsiella pneumoniae*, *E. coli*, and *Bacillus subtilis* [65]. Evidence for antimicrobial activity showed that the diterpenoid 16-oxocleroda-3,13E-dien-15-oic acid from the stem bark possessed the highest antimicrobial activity against *Aspergillus fumigatus*, *Saccharomyces caulbequence*, and *Saccharomyces cerevisiae*, *C. albicans*, *Hensila calgornica*, and kanamycin-resistant fungal strains [66]. A significant antibacterial potential was exhibited by stem bark extracts, and among them, the maximum activity was shown by the petroleum ether extract compared with chloroform, methanol, and water extracts [67].

16 α -hydroxy-cleroda-3,13 (14)-Z-diene-15,16-olide from the hexane extract of seeds showed strong antibacterial and antifungal activities [35]. The growth of *Fusarium solani*, a fungal pathogen, was significantly inhibited by the alcoholic leaf extract of *P. longifolia* [34]. The extract of various parts, such as ripe and unripe pericarps and leaves strongly inhibited various fungal strains, such as *Pythium aphanidermatum* and *Fusarium oxysporum* [68]. The seed oil of *P. longifolia* had a strong growth inhibitory potential against *S. aureus* [50]. Preparative thin layer chromatography isolates of the ethanolic extract of *P. longifolia* showed a significant level of inhibition potential against *E. coli*, *Klebsilla aerogenes*, *Pseudomonas aerogenes*, *Salmonella typhi*, *Shigella flexneri*, and *S. aureus* [69]. Clerodane diterpene 16 α -hydroxycleroda-3, 13 (14) Z-dien-15, 16-olide isolated from *P. longifolia* leaves exhibited inhibition against the methicillin-resistant *S. aureus*. Compounds showed synergistic interaction with antibiotics and good in vivo efficacy [70].

Antiplasmodial activity

P. longifolia leaf aqueous extract evaluated for in vivo

antimalarial activities in chloroquine-resistant *Plasmodium berghei* (ANKA) strain. It showed a suppression of parasite multiplication [71]. The ethanolic extract of *P. longifolia* stem bark showed strong antimalarial activities against drug-resistant *Plasmodium falciparum* infections [60].

Anticancer activity

The methanolic extract of *P. longifolia* leaves possessed a good efficacy toward prostate cancer cells. The extract had the ability to decrease cell growth and block the process in the G1/S phase of the cell cycle. *P. longifolia* induced apoptosis by the activation of the intrinsic apoptotic machinery [72]. Alcohol extract and chloroform fraction of *P. longifolia* leaves had the ability to induce apoptosis in different human cell lines, such as human leukemia HL-60 cells, SF 295 (CNS), and SW-620 (colon) [73]. Sari et al. studied the effect of 2 clerodane diterpenes, namely polyalthialdoic acid and 16 α -hydroxy-cleroda-3,13(14)Z-dien-15,16-olide, on human leukemia HL-60 cells, which were isolated from the ethyl acetate fraction of *P. longifolia* leaves extract. By using the MTT cell-viability assay, the treatment of human leukemia HL-60 cells with diterpenes indicated an inhibition of cell proliferation in a dose-dependent manner [74]. Vijayarathna et al. studied the anticancer effect of the methanolic extract of *P. longifolia* leaves and its mechanism of action. According to the study, the extract significantly showed a dose-dependent apoptosis and an arrest of cell cycle in G0/G1, G0/G1, and G2/M phases in cervical cancer cells (i.e., HeLa cells) [75]. The inhibition of human lung cancer cell line by the ethanol extract of *P. longifolia* leaves was also reported [69]. Christina et al. studied the anticancer activity of the methanolic extract of *P. longifolia* fruits. The study involved the use of N-nitrosodiethylamine and phenobarbital, which induced hepatocellular carcinoma in male wistar albino rats. According to study, the plant extract has the potential to correct liver tissue architecture. Moreover, it has the ability to reduce the number of nodules, serum α fetoprotein, DNA, and RNA contents in the liver [76]. Rupachandra and Sarada enzymatically extracted peptides from *P. longifolia* seeds. The study indicated the presence of 2 fractions, F1 and F2 peptides. According to the methyl tetrazolium assay, a significant cytotoxic activity against lung (A549) cancer cells was shown by the F2 peptide at 10 μ g/mL and cervical (HeLa) cancer cell lines at 30 μ g/mL [77].

Wound healing property

The wound healing effect of the ethanolic leaf extract of *P. longifolia* was examined using an excision wound model in rats. The study was assessed up to 14 days on the antero-dorsal side of the rats' skin. The extract showed wound healing action by wound contraction upon topical application [78]. The bark

extract of *P. longifolia* in different solvents, such as methanolic, n-hexane, and ethyl acetate for the isolation of active compounds, were responsible for the significant wound healing action. It increased the epithelization speed and contraction property of myofibroblasts and exhibited healing activity [79].

Hypoglycemic or antihyperglycemic activity

Lakshmi et al. evaluated the antidiabetic activity by administrating the bark extract of *P. longifolia* for 21 days in alloxan-induced diabetic rats. The study showed that the bark extract exhibited similar effectiveness to that of glipizide in controlling Type 1 diabetes. The bark extract in methanol, ethylacetate, and n-Hexane solvents showed a promising hypoglycemic activity by decreasing insulin levels. The extract also revealed homeostasis in biochemical parameters, such as cholesterol, urea, creatinine, and total protein as well as in enzyme activities [79]. The solvent extract of *P. longifolia* leaves had the ability to lower glucose levels; however it did not modify biochemical parameters. The extract showed an antihyperglycemic effect against sucrose-induced hyperglycemia [80]. The α -amylase and α -glucosidase enzymes catalyzed carbohydrate metabolism and increased plasma glucose level. The ethanol and chloroform extracts of the *P. longifolia* leaves had the ability to inhibit such enzymes. Therefore, the extract had the ability to reduce the rate of glucose absorption, which consequently inhibited a postprandial rise in plasma glucose [81].

Antipyretic activity

K Annan et al. examined the antipyretic activity of the methanol extract of the leaves, stem bark, and roots of the plant by using a lipopolysaccharide-induced antipyretic activity model. The plant extracts showed a significant antipyretic activity, which was typically higher than acetylsalicylic acid. The order of percentage of inhibition was root extract, leaf extract, and stem bark extract, respectively. The dose-dependent antipyretic activity of the plant made it suitable for the treatment of various ailments [82].

Anti-inflammatory activity

Sharma et al. investigated the anti-inflammatory activity by using a subacute inflammation model, namely cotton pellet granuloma. It provided evidence for the anti-inflammatory activity of ethanolic and aqueous fresh leaves extract of the plant [63]. Both extracts showed the anti-inflammatory activity owing to the presence of flavonoids and phenolic compounds [83]. An active clerodone diterpenoid of *P. longifolia* plant, 16-hydroxycleroda-3,13(14)E-dien-15-oic acid, had the ability to inhibit human neutrophil proinflammatory responses by blocking Ca²⁺, p38 mitogen-activated protein kinase, and Akt signaling pathways [84].

Antioxidant activity

The ethanol extract of the ripe pericarp of *P. longifolia* indicated the presence of high phenolic content; thus, the extract showed significant antioxidant activity [85]. The seed oil showed less antioxidant activity than ascorbic acid [50], whereas the methanolic extract of the leaves showed more activity than ascorbic acid [86]. Sampath and Vasanthi studied the ethanol extract of the leaves and showed the presence of three flavonoids, namely rutin, chrysin, and daidzein-related isomer, along with an unknown flavonoid. The flavonoids played a significant role in inducing antioxidant activity [69]. A promising antioxidant activity was exhibited due to the 3-O-methyl ellagic acid compound from the stem bark of the plant [10]. Sashidhara et al. identified the active constituents, namely quercetin, quercetin-3-O- β -glucopyranoside, and rutin, for activity by using the Trolox equivalent antioxidant capacity assay [87]. Proanthocyanidins from the plant leaves possess antioxidant and antityrosinase activities [88]. The methanolic extract of *P. longifolia* fruits had the potential to scavenge free radicals and showed maximum percentage of inhibition [89].

The genotoxic potential of the plant was studied by using plasmid relation, comet, and *Allium cepa* assay. Results of assays indicated the presence of genoprotective compounds against DNA damage, and the most effective concentration was found to be 100 g/mL. The extract exhibited significant inhibitory effects against H₂O₂-mediated DNA damage. The study predicted that the leaf extract can inhibit oxidative DNA damage and safe post-oral administration [90].

Hepatoprotective activity

Jothy and Aziz et al. demonstrated the hepatoprotective action of the plant by using a liver injury model. According to the study, *P. longifolia* had the ability to cure and protect various biochemical and histopathological changes occurring in various organs. In mice, the plant protected oxidative damage possibly by increasing the antioxidant protection mechanism [86]. The methanolic extract of *P. longifolia* fruits had the ability to protect from hepatic injuries and liver damage by decreasing elevated serum enzymes, bilirubin, and lipid peroxidation [89].

Antileishmanial agent

The 16 α -hydroxycyclohexa-3,13(14)Z-dien-15,16-olide from the fraction of crude ethanolic extract of the *P. longifolia* leaves showed a significant antileishmanial activity. Misra et al. studied the activity in both in vivo and in vitro. Results showed that the 16 α -hydroxycyclohexa-3,13(14)Z-dien-15,16-olide possessed good activity with no cytotoxicity. It had potency, safety, orally effectiveness, and showed

animal survival for more than 6 months. It specifically targeted the DNA topoisomerases enzyme of the target parasite [40].

Antiviral effect, as a laxative and an immunomodulator agent

Studies on the methanolic extract of *P. longifolia* leaves showed an antiviral activity. Viral replication is blocked by the inhibition of entry and budding of viruses [91]. Balamuruganvelu et al. studied the laxative activity of the plant by using wistar albino rats. The oral administration of ethanolic extract of *P. longifolia* bark showed a laxative activity similar to that of the reference drug, sodium picosulfate [92]. The ethanolic extract of *P. longifolia* leaves had an immunostimulatory effect on β and T lymphocytes and served for the treatment and prevention of immunodeficiency disorders [93].

Analgesic activity

The methanol, ethyl acetate, and benzene extracts of mature *P. longifolia* leaves had ability to exhibit analgesic activity. The methanol extract showed a potent analgesic activity followed by ethyl and benzene extracts [94]. Moniruzzaman et al. assessed the antinociceptive effects (action of blocking the detection of a painful stimulus) of the ethanolic extract of the stem bark of *P. longifolia*. The experiment was performed by using thermal and chemical models of nociception, such as glutamate and formalin-induced licking tests, hot-plate, and tail-immersion tests and acetic acid-induced writhing test. The extract showed a good antinociceptive activity in a dose-dependent manner [95].

Antihyperuricemic activity

Xanthine oxidase enzyme catalyzed the hydroxylation reaction of hypoxanthine to xanthine. Xanthine was further converted into uric acid [96]. The increase in the uric acid level in the body caused deterioration in glucose metabolism [97]. Hyperuricemia develops in various conditions, such as gout, hypertension, and renal damage [98]. The chloroform extracts of the *P. longifolia* leaves significantly showed an in vitro xanthine oxidase inhibitory activity [99].

Conclusion

P. longifolia has a supreme place in the Indian traditional medicinal system. This extensive literature survey reviewed that *P. longifolia* is a medicinal plant with a diverse pharmacological spectrum (Figure 1). It has a magnificent therapeutic efficiency conformed by preclinical trail studies. Along with its decorative use, it showed the existence of some unique chemical constituents with potential to destroy cancerous cell lines, such as prostate cancer cells, human leukemia HL-60 cells, lung (A549) cancer cells, SF 295 (CNS),

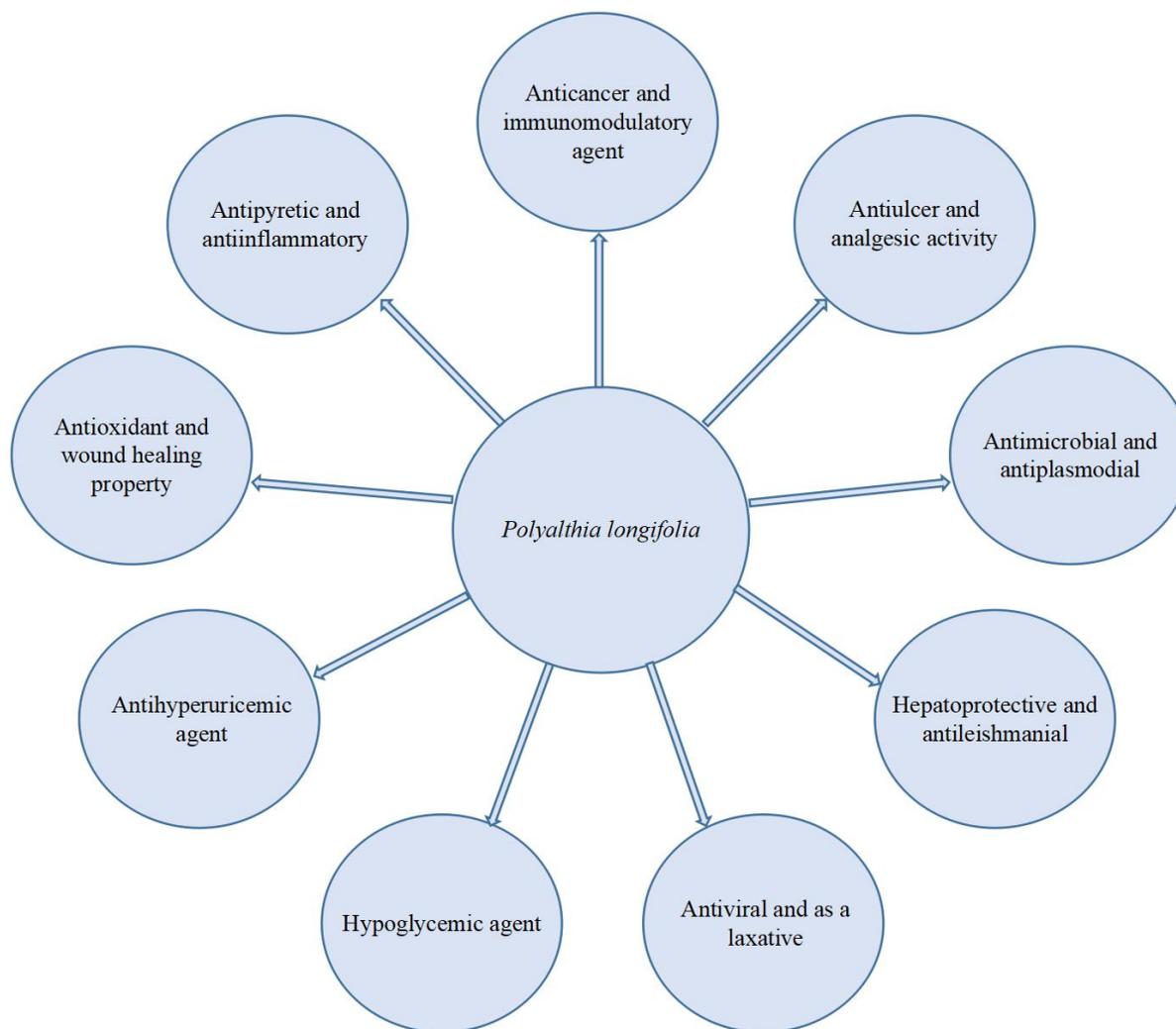


Figure 1 Pharmacological activity of *Polyalthia longifolia* plant

and SW-620 (colon). *P. longifolia* has a capacity to treat various ailments, including ulcers, gonorrhea, hyperuricemia, diabetes, liver injury, inflammation, and many more infectious diseases. The application of modern testing and evaluation techniques is necessary to explore new areas of plant efficacy. In the future, there is a need to execute clinical trials and development of suitable plant formulations with practical clinical application for the welfare of mankind.

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