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**Review Paper**

# Pajanelia longifolia (Willd.) K. Schum.: An Updated Review of Ethnomedicinal Uses, Phytochemistry and Biological Activities

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## ABSTRACT

Pajanelia longifolia (Willd.) K. Schum. (Bignoniaceae) is an ethnobotanically important deciduous tree distributed across parts of South and Southeast Asia, traditionally used for treating skin disorders, wounds, inflammation and other ailments. Despite its traditional importance, the species remains relatively underexplored scientifically. This review summarises the botanical characteristics, ethnomedicinal uses, phytochemical profile and biological activities of P. longifolia. The existing literature indicates that different plant parts contain diverse classes of secondary metabolites, including phenolics, flavonoids, terpenoids, sterols, fatty acids and related compounds, identified through preliminary phytochemical screening, chromatographic techniques and mass spectrometric analyses. Reported pharmacological activities include antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective and mosquitocidal effects, supported mainly by in vitro and experimental animal studies. Recent in silico investigations have also suggested potential anticancer activity. However, the available evidence remains limited by variations in plant material, extraction procedures and experimental models, while mechanistic, pharmacokinetic, long-term toxicological and clinical studies are lacking. Further research involving standardised extracts, bioactivity guided isolation and rigorous pharmacological and toxicological evaluation is required to establish the therapeutic potential of P. longifolia

## INTRODUCTION

The plant kingdom continues to be an important source of medicinal substances and many species are still being investigated for their therapeutic potential. Medicinal plants remain a valuable source of lead molecules for drug discovery because they provide structurally diverse bioactive compounds with a wide range of therapeutic potential. Among medicinal plant families, Bignoniaceae is well recognized for its ethnomedicinal value and phytochemical richness,

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with several species traditionally used for the treatment of inflammatory, microbial, hepatic, and metabolic disorders. [1,2,9]

Within this family, *Pajanelia longifolia* (Willd.) K. Schum. is a relatively underexplored tree distributed across parts of South and Southeast Asia that has long been used in folk medicine for skin diseases, wounds, inflammation, jaundice, and other ailments. Despite its traditional importance, scientific information on the species remains limited and scattered across ethnobotanical, phytochemical and pharmacological studies. Preliminary phytochemical screening, chromatographic profiling, mass spectrometric analysis and compound isolation studies have expanded current knowledge of its chemical composition. In parallel, biological investigations have reported antioxidant, antimicrobial, anti-inflammatory, hepatoprotective, antidiabetic and larvicidal activities along with emerging anticancer potential based primarily on *in silico* investigations. [3,4,5]

However, most of these studies remain preliminary and are based on *in vitro*, *in vivo* or *in silico* models, while the mechanistic basis of many of the reported effects remains insufficiently understood. This review summarizes the available literature on *Pajanelia longifolia* published up to 31 August 2026, with the aim of providing an updated overview of its ethnomedicinal uses, phytochemistry, biological activities and research gaps that need to be addressed in future pharmacognostical, pharmacological, and translational studies.

## LITERATURE SEARCH METHODOLOGY

Relevant literature on *Pajanelia longifolia* (Willd.) K. Schum. was identified through searches of Google Scholar using the species name as the principal search term. Additional relevant publications were identified from the reference lists of retrieved articles and from authoritative botanical sources. Original research articles, ethnobotanical reports, theses, and authoritative taxonomic databases reporting information specifically related to *P. longifolia* were included. Records not specifically involving *P. longifolia*, duplicate records and sources lacking retrievable bibliographic details were excluded. The literature was reviewed with particular emphasis on ethnomedicinal uses, phytochemistry, pharmacological activities and toxicological studies, including publications available up to 31 August 2026.

## TAXONOMIC CLASSIFICATION

*Pajanelia longifolia* (Willd.) K. Schum. belongs to the family Bignoniaceae within the order Lamiales. *Pajanelia* is a monotypic genus represented by the single accepted species, *P. longifolia*. The taxonomic classification of the species is given below. [7]

**Table 1. Taxonomic classification of *Pajanelia longifolia* (Willd.) K. Schum.**

| Taxonomic rank | Classification |
|---|---|
| Kingdom | Plantae |
| Clade | Angiosperms |
| Clade | Eudicots |
| Clade | Asterids |
| Order | Lamiales |
| Family | Bignoniaceae |
| Genus | *Pajanelia* |
| Species | *Pajanelia longifolia* (Willd.) K. Schum. |

## TAXONOMY AND BOTANICAL DESCRIPTION

*Pajanelia* is a monotypic genus in the family Bignoniaceae and order Lamiales, represented by the single accepted species *P. longifolia*. The species is distributed across parts of South and Southeast Asia, including the Western Ghats of India. It exhibits characteristic morphological features of Bignoniaceae, including a woody habit, opposite compound leaves, zygomorphic tubular flowers, didynamous stamens and a superior bicarpellary ovary. *Pajanelia* can be distinguished from other members of Bignoniaceae by its tall arborescent habit, very long imparipinnate leaves, large purple to crimson purple flowers with yellowish to cream colored interiors, nocturnal anthesis, and elongated, compressed capsules with winged seeds.

Morphologically, *P. longifolia* is a tall deciduous tree reaching up to approximately 30 m in height. It possesses a pale-grey, scaly bark with a whitish-brown to dull yellow inner blaze. The large, imparipinnate leaves may reach up to 120 cm in length and usually bear opposite leaflets together with a terminal leaflet. The leaflets are ovate in shape, chartaceous in texture and generally measure 8–24 cm in length and 3–10 cm in width. The flowers are large, bisexual and arranged in terminal panicles, with purple to crimson-purple coloration externally and cream colored to yellowish coloration internally. Flowering generally occurs from January to June. The flowers exhibit nocturnal anthesis, opening at night and fading by early morning. The fruit is a long, flattened and compressed capsule, approximately 30–50 cm in length and 6–8 cm in width. It contains numerous flat, winged seeds that facilitate wind dispersal. [5,6,7]

## DISTRIBUTION AND VERNACULAR NAMES

*Pajanelia longifolia* (Willd.) K. Schum. is distributed from southern India through parts of South and Southeast Asia, with records from Myanmar, Sri Lanka, Thailand and other parts of Southeast Asia. [5,6] In India, it has been reported from the Western Ghats and northeastern regions, occurring primarily in moist deciduous forest habitats. In southern India, the species has been documented from Kerala, Karnataka and Tamil Nadu. The species is known by several vernacular names across different regions, reflecting its association with diverse local ethnobotanical traditions. [5,6,7]

**Table 2. Vernacular names of *Pajanelia longifolia* (Willd.) K. Schum.** [29]

| Language | Vernacular name(s) |
|---|---|
| Malayalam | Azhantha, Pajaneli, Payyani |
| Kannada | Alangi, Bondubaale, Mokkuda |
| Tamil | Palai-y-utaicci |
| Konkani | Padwal |
| Hindi | Ban syona |
| Marathi | Daundi |
| Bengali | Jhingam |

## TRADITIONAL USES

*Pajanelia longifolia* has been used in traditional healing practices across parts of India particularly among indigenous and local communities. Ethnobotanical reports indicate that different plant parts are used for jaundice, skin disorders, wounds and other ailments, although the reported uses and methods of preparation vary among regions and communities. [3,4,8]

In North Tripura, the bark of *P. longifolia* has been documented as an infusion used for jaundice.[3] Ethnomedicinal investigations in southern Assam have also recorded *P. longifolia* among the medicinal plants used by the Chorei tribe.[26] In Karnataka, the bark has been reported in traditional practice for skin diseases, particularly eczema and wounds.[8]

However, these traditional uses have been documented primarily in several regional ethnobotanical studies and are based mainly on regional knowledge systems rather than standardized clinical evaluation. These reports provide useful leads for pharmacological and phytochemical investigations, although the reported uses, plant parts, and methods of preparation may vary among regions and communities.

**Table 3. Traditional medicinal uses of *Pajanelia longifolia* reported from ethnobotanical studies**

| Plant part | Preparation | Traditional use | Region/ communities | Reference |
|---|---|---|---|---|
| Bark | Infusion | Jaundice | North Tripura, Northeast India | [3] |
| Bark | Decoction; also used for washing wounds | Skin diseases, particularly eczema and wounds | Kalanjimale range, Dakshina Kannada, Karnataka | [8] |
| Bark | Dried bark soaked in water overnight; taken orally on an empty stomach for 4–5 days | Jaundice | Chorei tribe, Magura, Karimganj district, Assam | [26] |
| Leaves | Young tender leaves applied locally | Nail infections | Chorei tribe, Magura, Karimganj district, Assam | [26] |

## PHYTOCHEMISTRY

Phytochemical investigations of *P. longifolia* have identified diverse secondary metabolites, including flavonoids, phenolic compounds, terpenoids, sterols, fatty acids and their esters and other aromatic constituents. The reported chemical profile varies with plant part, extraction solvent and analytical technique. [10,13–17,25,28]

### Flavonoids and phenolic compounds

Flavonoids and phenolic constituents have been reported from *P. longifolia*. The study reported isolation and spectroscopic characterization of a compound described by the authors as 3′,4′,5,7-tetrahydroxy-3-O-rhamnoglucosyl flavonone from the ethanolic whole-plant extract following column chromatographic separation and spectroscopic profiling. [14] GC-MS/MS analysis of the methanolic leaf extract detected phenolic constituents including 4-vinylphenol, 2-methoxy-4-vinylphenol and 4-vinylbenzene-1,2-diol.[28] Metabolite profiling of the bark extract using LC-MS further reported compounds including prunetin, esculetin and isoacteoside.[11] These findings indicate the presence of diverse phenolic and flavonoid-related constituents in different preparations of *P. longifolia*. These constituents may contribute to the biological activities reported for the plant extracts; however, most of these compounds were detected or annotated through mass-spectrometric profiling rather than isolated and structurally characterized. Therefore, the contribution of individual compounds to the

observed biological effects has not been established. [12,16,19,20]

**Terpenoids and sterols**

Terpenoid and sterol constituents have been reported mainly from the leaves and bark. Phytol, neophytadiene and patchoulane were detected in leaf extracts by GC-MS, [13,15] while a recent GC-MS/MS investigation of the methanolic leaf extract reported squalene, loliolide and γ-sitosterol among the putatively identified constituents. [28] β-Sitosterol was also detected in the methanolic bark extract by GC-MS. [10] These findings indicate the presence of terpenoid and sterol metabolites in the chemical profile of *P. longifolia*, although the compounds reported through mass-spectrometric profiling should be regarded as tentative identifications unless confirmed using authentic standards or complementary structural characterization.

**Fatty acids and related compounds**

Fatty acids and their esters have been identified mainly in leaf extracts of *P. longifolia*. Reported constituents include hexadecanoic acid ethyl ester (ethyl palmitate), 9,12-hexadecadienoic acid methyl ester and 9,12,15-octadecatrienoic acid ethyl ester in the ethanolic leaf extract analysed by GC-MS. [13]The methanolic leaf extract was also reported to contain hexadecanoic acid ethyl ester, 9,12,15-octadecatrienoic acid and octadecanoic acid ethyl ester by GC-MS. [15] More recently, GC-MS/MS profiling of the methanolic leaf extract identified several fatty acids, their methyl esters and other lipid-derived compounds among the 76 detected constituents.[28] These findings indicate that fatty acids and related lipid-derived compounds form part of the reported chemical profile of *P. longifolia*.

**Other constituents**

2,3,6-trimethyloct-6-enal was isolated from the methanolic bark extract of *P. longifolia* and structurally characterized using spectroscopic techniques. [25] HRLC-MS profiling of different plant parts has also reported several putatively identified metabolites, including salicin and gentiopicrin in the stem, and harpagoside and icariin in the root. [17] More recently, LC-MS profiling of a bark extract reported additional metabolites, including byakangelicin**,** isoacteoside and aloesin, along with other annotated constituents. [11] Such mass spectrometric findings provide useful indications of the chemical constituents of *P. longifolia*, although further confirmation using authentic standards or isolation and spectroscopic characterization would strengthen the identification of these metabolites.

**Overall phytochemical profile**

The phytochemical investigations of *P. longifolia* have reported phenolic and flavonoid compounds, terpenoids, sterols, fatty acids and other constituents from different plant parts. Compounds such as the isolated tetrahydroxy-rhamnoglucosyl flavonone and 2,3,6-trimethyloct-6-enal have been structurally characterized, while several other constituents have been reported through GC-MS and LC-MS-based analyses. [10,11,13–17,25,28] The reported findings therefore represent a combination of isolated compounds and metabolites detected or annotated through chromatographic and mass-spectrometric approaches. Further phytochemical studies involving isolation, structural characterization and quantitative analysis would help to clarify the chemical composition of different plant parts of *P. longifolia*.

**Table 4. Major phytochemical groups reported from *P. longifolia***

| Phytochemical Class | Representative constituents | Plant part | Analytical method | Evidence/ identification status | Reference |
|---|---|---|---|---|---|
| Flavonoids | Tetrahydroxy-rhamnoglucosyl flavonone | Whole plant | Column chromatography and spectroscopy | Isolated and characterized | [14] |
| Phenolics | 4-Vinylphenol, 2-methoxy-4-vinylphenol | Leaf | GC-MS | MS-based identification | [28] |
| Flavonoids/ phenolic compounds | Prunetin, esculetin, isoacteoside | Bark | LC-MS | MS-based annotation | [11] |
| Terpenoid/ terpenoid related constituents | Phytol, neophytadiene, patchoulane, squalene, loliolide | Leaf | GC-MS | MS-based identification | [13,15,28] |
| Sterols | γ-sitosterol | Leaf | GC-MS/MS | MS-based identification | [28] |
| Fatty acids/ esters | Hexadecanoic acid ethyl ester, 9,12-hexadecadienoic acid methyl ester, 9,12,15-octadecatrienoic acid ethyl ester, octadecanoic acid ethyl ester | Leaf | GC-MS | MS-based identification | [13,15] |
| Other compounds | 2,3,6-Trimethyloct-6-enal | Bark | Spectroscopic characterisation-IR/ $^{1}$H NMR/ $^{13}$C NMR | Isolated and structurally characterised | [25] |
| Other reported/ annotated metabolites | Salicin, gentiopicrin, harpagoside, icariin | Stem / root | HRLC-MS | MS-based annotation | [17] |

## BIOLOGICAL ACTIVITIES

### Antioxidant Activity

Several *in vitro* studies have demonstrated antioxidant activity in *Pajanelia longifolia* extracts. Zainab et al. evaluated bark extracts prepared with water, methanol, ethanol and ethyl acetate and reported that the methanolic extract showed the highest antioxidant activity among the tested extracts. [12] Gini et al. subsequently evaluated aqueous and ethanolic extracts of the whole plant using DPPH, ABTS, hydroxyl radical, superoxide radical, nitric oxide radical and total antioxidant assays. The ethanolic extract showed greater antioxidant activity than the aqueous extract and the study reported isolation and spectroscopic characterisation of a compound 3′,4′,5,7-tetrahydroxy-3-O-rhamnoglucosyl flavonone. [14] In another study,

Saha et al. investigated bark extracts and found that the acetone extract contained comparatively higher levels of phenolics, flavonoids and alkaloids and demonstrated strong activity in several antioxidant assays, including DPPH, hydrogen peroxide scavenging, reducing power, metal chelation, and FRAP assays. [16] An additional study also reported antioxidant activity of *P. longifolia* inflorescence extracts in various *in vitro* assays, while the more recent study by Karim et al. found the aqueous fraction of the methanolic leaf extract to show the highest antioxidant activity among the tested fractions. [20,28]

Collectively, these findings indicate that *P. longifolia* possesses measurable antioxidant activity across different plant parts and extraction systems. The association between phenolic and flavonoid content and antioxidant activity suggests that these metabolite classes may contribute to the observed antioxidant effect of the extract; however, a direct relationship between individual constituents and antioxidant activity has not yet been conclusively established.

**Anti-inflammatory Activity**

Preclinical studies have evaluated the anti-inflammatory potential of *Pajanelia longifolia* using bark, leaf and inflorescence preparations. Asha et al. evaluated successive stem-bark extracts using the carrageenan-induced paw-oedema model in rats. The chloroform extract produced the greatest inhibition of paw oedema among the tested stem bark extracts, with 45.28% inhibition at 300 mg/kg, although its effect was lower than that of the standard drug indomethacin (67.92% inhibition at 10 mg/kg). [21] Shabeer et al. subsequently reported dose-dependent activity for an ethanolic leaf extract of *P. longifolia* using the carrageenan-induced paw-oedema model and an in vitro mast-cell degranulation assay, while Vijayan and Rani evaluated a 70% methanolic inflorescence extract in a carrageenan-induced paw-oedema model in mice and reported significant, dose-dependent inhibition of paw oedema. [19,20] Thus, anti-inflammatory effects have been observed with bark, leaf and inflorescence preparations across both *in vivo* and *in vitro* experimental models, although the differences in the extracts and models limit direct comparison of the reported effects.

**Antimicrobial Activity**

The antimicrobial potential of *Pajanelia longifolia* has been investigated using bark and leaf extracts. Zainab et al. evaluated water, 70% methanol, ethanol and ethyl acetate extracts of the bark against selected bacterial and fungal organisms. Ethanolic bark extract inhibited *Vibrio parahaemolyticus* and *Bacillus subtilis*, whereas *Escherichia coli* was not inhibited by any of the tested extracts. The methanolic extract also showed antifungal activity against the fungal isolates tested. [12] More detailed antibacterial evaluation was subsequently performed by Steffy et al. using petroleum ether, ethyl acetate, ethanol and aqueous leaf extracts against multidrug-resistant clinical isolates obtained from diabetic foot ulcers as well as standard bacterial strains, using disc-diffusion and MIC/MBC assays. Ethyl acetate and ethanol extracts demonstrated antibacterial activity against several organisms, including multidrug-resistant *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Acinetobacter baumannii*. [13] The findings indicate that antimicrobial activity is dependent on both the extract and the microorganism tested, with evidence for antibacterial and antifungal effects *in vitro*.

**Hepatoprotective Activity**

The hepatoprotective potential of *Pajanelia longifolia* has been demonstrated in experimental models of chemically induced liver injury. Datta

and Choudhury evaluated three fractions (PF1, PF2 and PF3) isolated from the ethyl acetate extract of the bark of *P. longifolia* against carbon tetrachloride ($CCl_4$)-induced hepatic damage in Swiss albino mice. The fractions were assessed using serum biochemical and oxidative stress parameters and the findings were supported by histopathological examination. Among the tested fractions, PF3 showed the strongest protective effect.[24] In a subsequent study, Datta and Choudhury isolated 2,3,6-trimethyloct-6-enal from the methanol extract of *P. longifolia* and evaluated its hepatoprotective activity against paracetamol-induced liver toxicity in Swiss albino mice. The compound showed protective effects at the tested doses, with the findings supported by biochemical and histopathological observations. [25] Together, these studies provide experimental evidence at both fraction and isolated-compound levels, although the findings are limited to chemically induced liver-injury models and cannot yet be extrapolated to human liver disease.

**Antidiabetic Activity**

The antidiabetic potential of *Pajanelia longifolia* has been investigated using extracts prepared from both bark and leaves in experimental models of diabetes. Asha et al. evaluated successive petroleum ether, chloroform, and methanol extracts of the stem bark using an alloxan-induced diabetic rat model. The bark extracts produced significant reductions in blood glucose levels, with the petroleum ether extract showing the greatest effect among the tested extracts during the 7-day treatment period. [21] Sreelakshmi et al. investigated the antidiabetic activity of an ethanolic leaf extract using streptozotocin-induced diabetic rats and an isolated rat hemidiaphragm model. Oral administration of the leaf extract at 100, 200 and 400 mg/kg for 28 days reduced blood glucose levels and increased muscle and liver glycogen content. In the isolated hemidiaphragm model, the extract enhanced glucose uptake and glycogen synthesis. [22] Acute oral toxicity testing at 2000 mg/kg produced no mortality during the 14-day observation period. [22] These findings suggest that both bark and leaf preparations can influence glucose-related parameters in experimental models, although the mechanisms responsible for these effects remain insufficiently defined. More recently, Karim et al. [28] also reported hypoglycemic activity of different fractions of the methanolic leaf extract, with the chloroform fraction showing the greatest activity among the tested fractions. This finding provides additional preliminary evidence for the glucose-lowering potential of *P. longifolia* leaves, although the mechanism responsible for the observed effect remains to be established.

**Antidiarrheal Activity**

Karim et al. [28] also investigated the antidiarrheal potential of methanolic leaf extract fractions of *Pajanelia longifolia* using the castor oil-induced diarrhoea model. Among the tested fractions, the chloroform fraction demonstrated the greatest antidiarrheal activity. [28] This finding provides preliminary experimental evidence for the antidiarrheal potential of *P. longifolia* leaves, although the underlying mechanism and active constituents remain to be established.

**Analgesic Activity**

Karim et al. [28] further evaluated the analgesic potential of methanolic leaf extract fractions of *Pajanelia longifolia* using tail-immersion and acetic acid-induced writhing models. The n-hexane fraction showed notable central analgesic activity, whereas the ethyl acetate fraction demonstrated notable peripheral analgesic activity.[28] These findings provide preliminary experimental evidence for analgesic activity of *P. longifolia* leaves, although further studies are

required to clarify the mechanisms and identify the constituents responsible for these effects.

**Mosquitocidal Activity**

The mosquitocidal potential of *Pajanelia longifolia* has been investigated using leaf extracts against the malaria vector *Anopheles stephensi*. Sowmyashree et al. evaluated crude extracts prepared with petroleum ether, chloroform, and methanol leaf extracts for oviposition deterrent, ovicidal, larvicidal, and pupicidal activities. Among these, the methanol extract exhibited the highest activity, with marked oviposition deterrence and strong ovicidal, larvicidal, and pupicidal effects at the tested concentrations. The methanol extract showed an $LC_{50}$ of 446.56 ppm and an $LC_{90}$ of 750.65 ppm against *A. stephensi* larvae after 24 h of exposure. [23] These findings demonstrate activity against multiple developmental stages of the mosquito under laboratory conditions although the effectiveness of the crude extract under more realistic environmental or field conditions remains unknown.

**In Silico Anticancer Potential**

Recent computational studies have provided preliminary evidence for the anticancer potential of *Pajanelia longifolia*. Nath et al. investigated GC-MS detected metabolites from the methanolic bark extract together with previously reported phytochemicals in molecular docking studies against EGFR and TGF-βRI, two key proteins involved in tumour growth and progression, using molecular docking. Several compounds showed favourable predicted binding interactions with these cancer-associated targets, with rescinnamine emerging as a particularly promising candidate based on its docking and predicted pharmacokinetic properties. However, the study did not establish rescinnamine as an experimentally isolated constituent of P. longifolia bark, and the computational findings therefore require experimental validation. [10] In another in silico study, bark-derived compounds of *P. longifolia* were investigated against targets associated with non-small-cell lung cancer, with computational analyses suggesting potential involvement of apoptosis-related pathways. [11] More recently, Das et al. used an integrated computational approach to investigate *P. longifolia* bark-derived compounds against hepatocellular carcinoma-associated hub genes, including BUB1, BUB1B, CCNA2, CCNB1, CDK1, and KIF11. Selected compounds showed favourable molecular docking and drug-likeness profiles, while molecular dynamics simulations supported the stability of the predicted ligand–protein complexes. [27] These studies generate hypotheses regarding potentially relevant compounds and molecular targets, but the predicted interactions do not establish anticancer efficacy and require experimental validation.

**Toxicological Studies**

The toxicological profile of *Pajanelia longifolia* has been evaluated mainly using methanolic leaf extract. Sowmyashree et al. assessed the *in vitro* cytotoxicity of the extract in the NIH/3T3 cell line and evaluated its acute oral toxicity in female Wistar rats. A single oral dose of 2000 mg/kg body weight in female Wistar rats produced no mortality during the 14-day observation period. The study also reported no significant changes in behavioural pattern, body weight, relative organ weights, haematological parameters, biochemical markers, or histopathological findings, suggesting a favourable short-term safety profile for the leaf extract at the tested dose. [15] These findings indicate low acute toxicity under the conditions tested but they do not provide sufficient information on repeated dose exposure, long term

toxicity or the safety of the other plant parts and extract types.

**Table 5. Reported biological activities of *Pajanelia longifolia* (Willd.) K. Schum.**

| Biological activity | Plant part / extract | Experimental model / assay | Main finding | Reference |
|---|---|---|---|---|
| Antioxidant | Bark extracts | Various *in vitro* antioxidant assays | Bark extracts demonstrated antioxidant activity, with activity varying according to the extraction solvent. | [12,16] |
| Antioxidant | Whole plant extract | DPPH, ABTS, hydroxyl radical, superoxide and nitric oxide assays | The ethanolic extract showed greater antioxidant activity; a flavonoid was isolated from the extract. | [14] |
| Antioxidant | Root bark | Antioxidant and free-radical scavenging assays | *P. longifolia* root bark was included in a comparative assessment of antioxidant and polyphenol content. | [18] |
| Antioxidant | Inflorescence extract | DPPH, ABTS, superoxide radical-scavenging and lipid-peroxidation inhibition assays | Inflorescence extract demonstrated antioxidant activity in the tested *in vitro* assays. | [20] |
| Antioxidant | Leaf extract | DPPH radical scavenging assay | The aqueous fraction showed the strongest antioxidant activity among the tested fractions. | [28] |
| Anti-inflammatory | Leaf extract | Carrageenan-induced paw-oedema and mast-cell degranulation assays | Ethanolic leaf extract demonstrated significant anti-inflammatory activity. | [19] |
| Anti-inflammatory | Inflorescence extract | Carrageenan-induced paw-oedema model | Inflorescence extract significantly reduced carrageenan-induced paw oedema in a dose-dependent manner. | [20] |
| Anti-inflammatory | Bark extract | Carrageenan-induced paw oedema model | Bark extracts inhibited paw oedema; the chloroform extract showed the greatest inhibition among the tested extracts. | [21] |
| Antimicrobial | Bark extracts | Antimicrobial assays | Bark extracts exhibited antimicrobial activity | [12] |

| | | | | |
|---|---|---|---|---|
| | | | against selected microorganisms. | |
| Antibacterial | Leaf extract | Clinical isolates and standard bacterial strains; antibacterial assays | Leaf extracts showed antibacterial activity against several tested organisms, including multidrug-resistant isolates. | [13] |
| Hepatoprotective | Bark extract / ethyl acetate fractions (PF1-PF3) | $CCl_4$-induced hepatic injury in mice | PF3 showed the strongest hepatoprotective effect and reduced biochemical and oxidative indicators of hepatic injury; findings were supported by histopathological examination. | [24] |
| Hepatoprotective | Isolated compound | Paracetamol-induced liver injury model | The isolated compound 2,3,6-trimethyloct-6-enal demonstrated antihepatotoxic potential in an experimental model. | [25] |
| Antidiabetic | Leaf extract | Streptozotocin-induced diabetic rats; isolated hemidiaphragm model | Leaf extract reduced blood glucose and increased liver and muscle glycogen content; the extract also enhanced glucose uptake in the isolated hemidiaphragm model. | [22] |
| Antidiabetic | Bark extract | Alloxan-induced diabetic rat model | Bark extracts showed significant reductions in blood glucose levels in alloxan induced diabetic rats. | [21] |
| Hypoglycemic | Leaf extract | Oral glucose tolerance test | The chloroform fraction showed the greatest hypoglycemic activity among the tested fractions. | [28] |
| Antidiarrhoeal | Leaf extract | Castor-oil induced diarrhoea test | The chloroform fraction showed the greatest antidiarrheal activity among the tested fractions. | [28] |
| Analgesic | Leaf extract | Tail immersion and acetic acid induced writhing models | The n-hexane fraction showed notable central analgesic activity, whereas the ethyl acetate fraction | [28] |

| | | | | |
|---|---|---|---|---|
| | | | showed notable peripheral analgesic activity. | |
| Mosquitocidal | Leaf extracts | *Anopheles stephensi* oviposition, ovicidal, larvicidal and pupicidal assays | Leaf extracts showed oviposition-deterrent, ovicidal, larvicidal and pupicidal activity against *Anopheles stephensi* under laboratory conditions. | [23] |
| In silico anticancer | Bark extract constituents | Molecular docking and computational analysis | Several bark derived compounds showed favourable predicted interactions with cancer-associated targets, including EGFR and TGF-βRI, while other studies investigated compounds against NSCLC and hepatocellular carcinoma associated targets. | [10,11,27] |
| Toxicological evaluation | Methanolic leaf extract | NIH/3T3 cytotoxicity assay; acute oral toxicity in female Wistar rats | The extract showed limited cytotoxicity in NIH/3T3 cells and produced no mortality or significant toxicological changes following a single oral dose of 2000 mg/kg. | [15] |

## DISCUSSION

*Pajanelia longifolia* has documented ethnomedicinal uses, particularly in Northeast India, and has been investigated for a range of phytochemical and pharmacological properties. [3,4,26] Experimental studies have reported antioxidant, anti-inflammatory, antimicrobial, hepatoprotective, antidiabetic, and mosquitocidal activities from different plant parts and extracts. [12–25] However, the available evidence remains predominantly preclinical and varies according to plant part, extraction method, and experimental model.

The reported biological activities appear to be influenced by the plant part and extraction solvent. Differences in antioxidant activity have been reported among extracts prepared using different plant parts. [12,14,16,18,20] The presence of phenolic and flavonoid constituents in some extracts may contribute to the observed antioxidant effects, although direct attribution of activity to individual compounds remains limited. [14,16,18] Recent GC-MS/MS-based profiling of *P. longifolia* leaves further expanded the reported phytochemical composition and combined chemical characterization with experimental and computational evaluation. [28] These findings support continued investigation of the relationship

between phytochemical composition and biological activity.

The pharmacological evidence ranges from *in vitro* assays to experimental animal models. [12–25] Animal studies have provided evidence for hepatoprotective, anti-inflammatory and antidiabetic effects, while in vitro investigations have demonstrated antioxidant and antimicrobial activity. [13,19–25] Nevertheless, differences in plant material, extraction procedures, doses and experimental models make direct comparison between studies difficult. Standardized extracts and quantitative phytochemical profiling would therefore be useful for improving reproducibility and establishing clearer relationships between chemical composition and biological activity.

The anticancer evidence is currently more preliminary than the other reported activities, as the available studies are based mainly on molecular docking and related computational approaches. [10,11,27] These studies identify possible interactions between *P. longifolia* constituents and cancer-associated targets, but computational predictions cannot establish anticancer efficacy. They are therefore best regarded as hypothesis-generating evidence that requires confirmation through cellular, animal and ultimately clinical studies.

Overall, the available evidence indicates that *P. longifolia* contains chemically diverse constituents associated with several experimentally observed biological activities; however, the current evidence does not establish therapeutic efficacy in humans. The toxicological evidence is also limited mainly to acute toxicity assessment of a methanolic leaf extract. [15] Further research should focus on standardized preparations, quantitative phytochemical characterization, bioactivity-guided isolation, mechanistic studies, pharmacokinetic evaluation, and longer-term toxicity assessment. At present, *P. longifolia* is better regarded as a promising subject for pharmacological investigation rather than a clinically established therapeutic agent.

## CONCLUSION

*Pajanelia longifolia* has documented ethnomedicinal uses and a diverse reported phytochemical profile, with studies indicating antioxidant, antimicrobial, anti-inflammatory, hepatoprotective, antidiabetic, and mosquitocidal activities. The available studies provide preliminary experimental evidence for these activities; however, the evidence is predominantly derived from *in vitro* assays, experimental animal models and computational studies.

Further research is required to develop standardized extracts, isolate and characterize bioactive constituents, establish their mechanisms of action and evaluate pharmacokinetic and long-term safety profiles. Well-designed *in vivo* and clinical studies are also needed to determine the therapeutic relevance of the reported activities. At present, *P. longifolia* can be considered a promising source of bioactive compounds for further pharmacognostic and pharmaceutical investigation rather than a clinically established therapeutic agent.

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