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Systematic review on phytochemistry and ethnopharmacology of *Brachypterum scandens* (Roxb.) Wight & Arn.ex Miq.

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Brachypterum scandens (Roxb.) Wight & Arn.ex Miq. (syn. *Derris scandens*), an evergreen woody climber of the Fabaceae family, is widely recognised across Southeast Asia for its extensive application in traditional Indian, Chinese, and Thai medical systems. Ethnopharmacologically, the plant—particularly its stem, bark, and roots—is prescribed to alleviate musculoskeletal pain, osteoarthritis, inflammation, dysentery, and cardiovascular distress, and serves as an official herbal medicine in the Thai National List of Essential Medicines. Phytochemical investigations have revealed that *B. scandens* is rich in prenylated isoflavonoids, flavonoids, coumarins, triterpenoids, and phytosterols. Key bioactive compounds isolated include derrisisoflavones A–F, lupalbigenin, genistein-7-O-[*α*-rhamnopyranosyl-(1→6)-*β*-glucopyranoside] (GTG), 6,8-diprenylgenistein, scandenin, scandenone, betulinic acid, lupeol, and β-sitosterol. Pharmacological evaluations systematically validate these traditional claims, demonstrating potent anti-inflammatory effects through the inhibition of COX-2, iNOS, 5-LOX, TNF-*α*, and NF- NF-*κ*B pathways. Furthermore, extracts and isolated phytoconstituents display significant cytotoxicity and pro-apoptotic activity against diverse human cancer cell lines (e.g., MCF-7, HT-29, HepG2, and A549), along with marked antimicrobial, antioxidant, wound-healing, hypoglycemic, thrombolytic, and insecticidal properties. This systematic review synthesises the ethnopharmacological applications, phytochemical profile, and reported pharmacological mechanisms of *B. scandens*, providing a scientific foundation for future targeted drug discovery and clinical development.

Keywords: Anti-inflammatory, *Brachypterum scandens*, *Derris scandens*, Ethnopharmacology, Lupalbigenin, Phytochemistry, Prenylated isoflavonoids

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Introduction

Brachypterum scandens (Roxb.) Wight & Arn.ex Miq. (syn. *Derris scandens* (Roxb.) Benth.), commonly known as the "Jewel Vine," is a prominent woody climbing liana native to the tropical and subtropical regions of Southeast Asia, particularly India, Thailand, Malaysia, and China. While belonging to the species-rich Fabaceae family[1], *B. scandens* warrants focused scientific investigation due to its unique standing at the intersection of traditional medicine systems and modern natural product drug discovery.

Unlike many underutilised botanical species, *B. scandens* holds a distinguished place in official healthcare frameworks; for example, its stem extracts are formally listed in the *Thai National List of Essential Medicines* for the management of musculoskeletal pain and osteoarthritis. Historically prescribed across Ayurvedic, Traditional Chinese, and Thai medical traditions, the plant's bark, roots, and stems have been extensively used to treat chronic inflammatory disorders, dysentery, muscular stiffness, vascular ailments, and generalised debility[2,3].

Phimarn *et al*.,[4] reported a systematic review and meta-analysis on efficacy of *B. scandens* for its pain relieving properties. Deachathai[5] issued chemical constituents and biological activities of *B. scandens*. Madhiri, *et al*.,[6] published phytochemical and pharmacological aspects of the plant based on only 5 to 6 significant active constituents, some of pharmacological aspects and identification tests for active constituents. Geol, *et al*.,[7] reported a review on therapeutic potential of genus *Pongamia* and *Derris* with their phytochemical and bioactivity studies. Patil, *et al*.,[8] illustrated different compounds isolated and therapeutic potential of the plant in a book chapter of "Bioactives and Pharmacology of

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Legumes". They also could report only few bioactive compounds. Nha, *et al.*,[9] systematically provided research results on the chemical composition and biological activities of *Derris* species. As this two reviews focussed genus level it couldn't extract all the literature available on *B. scandens*. The present systematic review aims to comprehensively synthesize the available literature on *B. scandens* incorporating relevant literature published under its taxonomic synonyms. The review systematically evaluates its ethnopharmacological uses, geographical and traditional medicinal contexts, phytochemical constituents across different plant parts, experimentally demonstrated pharmacological activities, and available clinical and safety evidence.

The selection of *B. scandens* for this systematic review is justified by three key factors:

Therapeutic and Pharmacological Significance: Despite its widespread traditional use as an effective remedy for pain and inflammation[10], there is a crucial need to critically evaluate how modern biological assays validate these ethnomedicinal claims, particularly regarding its molecular mechanisms of action (e.g., inhibition of pro-inflammatory mediators like COX-2, 5-LOX, and NF-κB pathways).

Phytochemical richness: The plant serves as a prolific source of structurally diverse bioactive secondary metabolites, notably prenylated isoflavonoids (such as *lupalbigenin* and *derrisisoflavones*), coumarins, and triterpenoids[3]. The unique chemical architecture of these isolated compounds presents valuable lead scaffolds for natural product-based drug design[2].

Fragmentation of Existing Literature: While numerous isolated studies have explored individual phytochemicals or localised pharmacological activities of *B. scandens*[2,11,12] there remains a lack of a comprehensive, updated synthesis that bridges its ethnopharmacology, phytochemistry, and safety profiles.

To address these gaps, this review aims to achieve the following specific objectives:

Systematize Ethnopharmacological Data: Provide a detailed overview of the traditional usages, medicinal formulations, and ethnobotanical applications of *B. scandens* across diverse geographical regions.

Map the Phytochemical Landscape: Critically catalogue the secondary metabolites isolated from various plant parts (stems, roots, leaves, and bark), highlighting key bioactive marker compounds and their structural classifications.

Evaluate Pharmacological Evidence and Mechanisms: Comprehensive review of modern *in vitro* and *in vivo* biological activities—including anti-inflammatory, cytotoxic, antimicrobial, antioxidant, and cardioprotective effects—with an emphasis on underlying molecular targets.

Identify Knowledge Gaps & Future Directions: Highlight existing toxicological, pharmacokinetic, and clinical research gaps to guide future translational research and therapeutic development of *B. scandens*.

Literature collection

An exclusive search was performed through all scientific databases such as Google Scholar, Science Direct, Scopus, Ebsco, PubMed, etc from the year 1999 to 2026. All articles related to the *B. scandens* plant were collected, and the reference lists of reviewed articles were also checked for relevant data. The search terms like 'ethno medicinal', 'phytochemistry', 'plant extract' 'compound isolation', 'pharmacological actions' etc. were used for the journal search along with other synonyms. The classical literature was also checked for documenting the valuable medicinal properties of *B. scandens*. Unpublished data, data from proceedings of conferences, etc., were excluded from analysis.

Out of 4000 articles of literature searched from 1999 to 2026, 66 articles with 46 experiments are included in this systematic review. Unpublished data, duplicated papers, and conference proceeding abstracts were excluded from the systematic review. In the *in vitro* studies, different plant extracts of *B. scandens* from various plant parts were tested. This paper summarises various studies pertaining to chemicals isolated from *B. scandens*, and their activities.

Diversity and geographical distribution

B. scandens is a long woody climbing shrub with twisted stems that can grow up to 20 m long, emerging from the taproot[3]. It is widely distributed throughout Asia and Australia, particularly in Indo-Malesia and Thailand. It is found in deciduous forests, sacred groves, and mangroves.

Synonyms: *Dalbergia scandens* Roxb., *Dalbergia timoriensis* DC.

Common Name: Hog Creeper, Jewel Vine

Other names - Assamese: SubaiSali; Bengali: Amakurchi; Hindi: Gonj; Kannada: China bilimara; Konkani: Salori; Malayalam: Noyalvalli, nulvalli;

Marathi: Garudvel; Tamil: Koti-p-punku; Telugu: Chiratalliboddu; Tulu: Eli ballu (India)[13].

Botanical description

The plant is an evergreen climbing branched shrub; tap rooted; stems twining, bark brown coloured with lenticels; leaves green, compound, alternate, 19 cm long; leaflets entire, ovate-oblong or elliptic-lanceolate, measuring 5 to11 in length and 2 to 5 cm wide, blunt, glabrous; apex obtuse, acute, base rounded to cuneate; inflorescence raceme with pea like flowers clustered on brown-pubescent rachis; petals pink; standard petal 7 to 10 mm long; ovate-orbicular; stamens 10, alternate ones short; fruit is a pod; 2.5 to 7.5 cm long, 0.9 to 1.2 cm broad, narrow, 2 to4 seeded; seeds dark brown, reniform, compressed, up to 8 mm long[1,13].

Ethnomedicinal values

B. scandens is used for curing various diseases in traditional medicine. It has been used for relieving the pain related to headaches, muscle twinges, arthritis, and joints[3,12,14]. It has been utilised since ancient times for its medicinal values in traditional Indian, Chinese, and Thai remedies. The woody twine part of the plant was used as an expectorant, diuretic, antidysenteric, anti-tussive, and pain reliever for joints and muscles. It is used to treat osteoarthritis and inflammation[3,10,12]. It is also considered a herb for wellness with cancer prevention and is used for curing the difficulties associated with post menopause and cardiac problems[11,12,15]. Thailand has included dry powder of *B. scandens* as a herbal product in the National List of Essential Medicines against musculoskeletal pain[15]. It has been found that the natives of Sri Lanka also used this plant for the treatment of wounds due to its wound-healing activity. The bark is a cholagogue and is used as a fish poison. It is also used in snake bite[16]. The extract of this plant was used in traditional fishing practices[17] as it has strong insecticidal properties. The bulb is used for chest pain. Root powder is used in snakebite. The root juice increases milk secretion[16]. In folklore medicine, the oil prepared with stem bark and gingelly oil is given internally for atrophy of muscles and also for epilepsy[18]. Decoction of the bark is given internally for snake bite[19].

Phytochemistry

Preliminary phytochemical studies

Maharabam *et al.*[20] reported the presence of phytochemicals such as saponin, alkaloid, glycosides, terpenoid, tannins, phenol, and steroid in the bark extracted with petroleum ether, chloroform, and water.

Isolated compounds

Several pure compounds have been isolated from different plant parts of *B. scandens* with elucidation of their chemical structures. All the compounds showed potential therapeutic effects, revealing the potency of the plant in drug development (Table 1). The chemical structure of each compound is depicted in Fig. 1.

Minerals

Maharabam *et al.*[20] reported the presence of minerals such as Na, K, Fe, Mg, Ca, As, V, Cr, Mn, Ni, Co, Cu, and Pb in the bark of *B. scandens.*

Pharmacological activities

Several therapeutic activities have been reported for the *B. scandens* plant. Anticancer and anti-inflammatory studies reported by various researchers are documented in the following tables (Tables 2 and 3, respectively).

Antioxidant activity

The antioxidant potential of the plant was studied by Mukit *et al.*[26], by using different plant extracts of *B. scandens,* such as ethyl acetate and chloroform. The effects of extracts on free radical scavenging activity were remarkable in the DPPH assay. Ascorbic acid was used as the reference/standard antioxidant. Among the fractions, the ethyl acetate and chloroform soluble fractions showed the strongest DPPH-scavenging activity.

An investigation of antioxidant potential of *B. scandens* methanolic leaf extract was evaluated by using DPPH, phospho molybdenum total antioxidant assay, reducing power assay and hydrogen peroxide assay. The reported percentage inhibition of extract from 35.92% to 92.22% with IC50 values of 285.71 µg/mL shows the efficacy of the plant in scavenging the oxidants. The phospho molybdenum total antioxidant assay showed formation of a green phosphate/Mo complex with a maximal absorption at 695 nm and activity ranged from 80% to 94% in *B. scandens.* The reducing assay also showed dose dependent increase in antioxidant activity[52].

Another study reported comparative *in vitro* antidiabetic and antioxidant activity of *Pulicaria wightinia*, *Curcuma inodora*, *Derris scandens* leaf extracts. Antioxidant activities of three different extracts were evaluated by DPPH scavenging assay

Table 1 — List of phytochemical compounds isolated from *B. scandens*

S No	Plant Part	Chemical compound	Class	Formula	Structure	Bioactivity	References
1	Stem	Derrisisoflavone A	Isoflavonoid	$C_{26}H_{28}O_5$	Fig. 1.1	Anti-inflammatory and anticancer activity	2,21,22
2	Stem	Derrisisoflavone B	Isoflavonoid	$C_{25}H_{26}O_6$	Fig. 1.2	NAR	2
3	Stem	Derrisisoflavone C	Isoflavonoid	$C_{26}H_{28}O_6$	Fig. 1.3	NAR	
4	Stem	Derrisisoflavone D	Isoflavonoid	$C_{26}H_{28}O_6$	Fig. 1.4	NAR	
5	Stem	Derrisisoflavone E	Isoflavonoid	$C_{26}H_{28}O_6$	Fig. 1.5	NAR	
6	Stem	Derrisisoflavone F	Isoflavonoid	$C_{25}H_{26}O_6$	Fig. 1.6	NAR	
7	Stem	Lupinisol A	Isoflavonoid	$C_{25}H_{26}O_6$	Fig. 1.7	NAR	
8	Stem	Lupinisoflavone G	Isoflavonone	$C_{25}H_{26}O_6$	Fig. 1.8	NAR	
9	Stem	Erysenegalensein E	Isoflavonoid	$C_{25}H_{26}O_6$	Fig. 1.9	Anticancer	2,23
10	Leaf and Root	Ovaliflavanone	Flavonoid	$C_{25}H_{28}O_3$	Fig. 1.10	Anti-inflammatory	24
11	Leaf and Root	Lupinifolin	Flavonoid	$C_{25}H_{26}O_5$	Fig. 1.11	Anti-inflammatory	
12	Stem	Lupalbigenin	Isoflavonoid	$C_{25}H_{26}O_5$	Fig. 1.12	Anti-inflammatory, anticancer	21,22,25,26,
13	Root	Scandenin	Coumarin	$C_{26}H_{26}O_6$	Fig. 1.13	Antibacterial, antifungal and antialgal	11
14	Root	Scandenin A	Coumarin	$C_{27}H_{28}O_6$	Fig. 1.14	Antibacterial, antifungal and antialgal	
15	Root and stem	*β*-Amyran-3-one	Triterpenoid	$C_{30}H_{48}O$	Fig. 1.15	NAR	
16	Root and stem	*β*-Sitosterol glucopyranoside	Phytosterol	$C_{35}H_{60}O_6$	Fig. 1.16	NAR	
17	Root and stem	*β*-Amyrin	Triterpene	$C_{30}H_{50}O$	Fig. 1.17	Cytotoxic and apoptotic	11,27
18	Root and stem	Betulinic acid	Triterpene	$C_{30}H_{48}O_3$	Fig. 1.18	Anti-inflammatory, antibacterial, antiviral, antidiabetic, antimalarial, anti-HIV and antitumor	11,28
19	Root and stem	*β*-Sitosterol	Phytosterol	$C_{29}H_{50}O$	Fig. 1.19	Anticancer, anti-inflammatory, analgesic activity, antidiabetic, antioxidanty, wound healing and protective effects, antibacterial and antiviral activities	11,29,30, 31,32
20	Stem	Scandenone	Flavonoid	$C_{25}H_{24}O_5$	Fig. 1.20	Antibacterial	26,33,
21	Leaf	Derriscandenon A	Flavonoid	$C_{21}H_{18}O_7$	Fig. 1.21	Anticancer	12
22	Leaf	Derriscandenon B	Flavonoid	$C_{21}H_{18}O_7$	Fig. 1.22	Anticancer	
23	Leaf	Derriscandenon C	Flavonoid	$C_{25}H_{26}O_7$	Fig. 1.23	Anticancer	
24	Stem	Lupeol	Triterpene	$C_{30}H_{50}O$	Fig. 1.24	Wound healing and anti-inflammatory	34
25	Stem	Genistein	Flavonoid	$C_{15}H_{10}O_5$	Fig. 1.25	Wound healing, anti-inflammatory and anticancer	21,22,35
26	Stem	Derriscandenon D	Flavonoid	$C_{26}H_{26}O_6$	Fig. 1.26	Anticancer	36
27	Stem	Derriscandenon E	Flavonoid	$C_{25}H_{24}O_6$	Fig. 1.27	Anticancer	
28	Stem	Derriscandenon F	Flavonoid	$C_{25}H_{24}O_7$	Fig. 1.28	Anticancer	
29	Stem	Derriscandenon G	Flavonoid	$C_{25}H_{24}O_7$	Fig. 1.29	Anticancer	
30	Stem	Millewanin E	Isoflavonoid	$C_{25}H_{24}O_7$	Fig. 1.30	Antiproliferative	
31	Stem	Rhynedlin A	Isoflavone	$C_{25}H_{22}O_5$	Fig. 1.31	Antiproliferative	
32	Stem	Isolupalbigenin	Isoflavonoid	$C_{25}H_{26}O_5$	Fig. 1.32	Anticancer	
33	Stem	Isoscandinone	Isoflavonoid	$C_{25}H_{24}O_5$	Fig. 1.33	Antiproliferative activity	

{Contd.)

Table 1 — List of phytochemical compounds isolated from *B. scandens (Contd.)*

S No	Plant Part	Chemical compound	Class	Formula	Structure	Bioactivity	References
34	Whole plant	Chandalone	Isoflavonoid	$C_{25}H_{24}O_5$	Fig. 1.34	NAR	37
35	Whole plant	Nallanin	Isoflavonoid	$C_{26}H_{26}O_5$	Fig. 1.35	NAR	
36	Whole plant	Lonchocarpic acid (Chandanin)	Flavonoid	$C_{26}H_{26}O_6$	Fig. 1.36	NAR	
37	Whole plant	Lonchocarpenin	Isoflavonoid	$C_{27}H_{28}O_6$	Fig. 1.37	NAR	
38	Whole plant	Osajin	Flavonoid	$C_{25}H_{24}O_5$	Fig. 1.38	Antibacterial	37,38
39	Whole plant	Robustic acid	Flavonoid	$C_{22}H_{20}O_6$	Fig. 1.39	Antitumor	37,39
40	Stem	6,8-diprenylgenistein	Isoflavone	$C_{25}H_{26}O_5$	Fig. 1.40	Anticancer, antibacterial	22,38

NAR - No activities reported

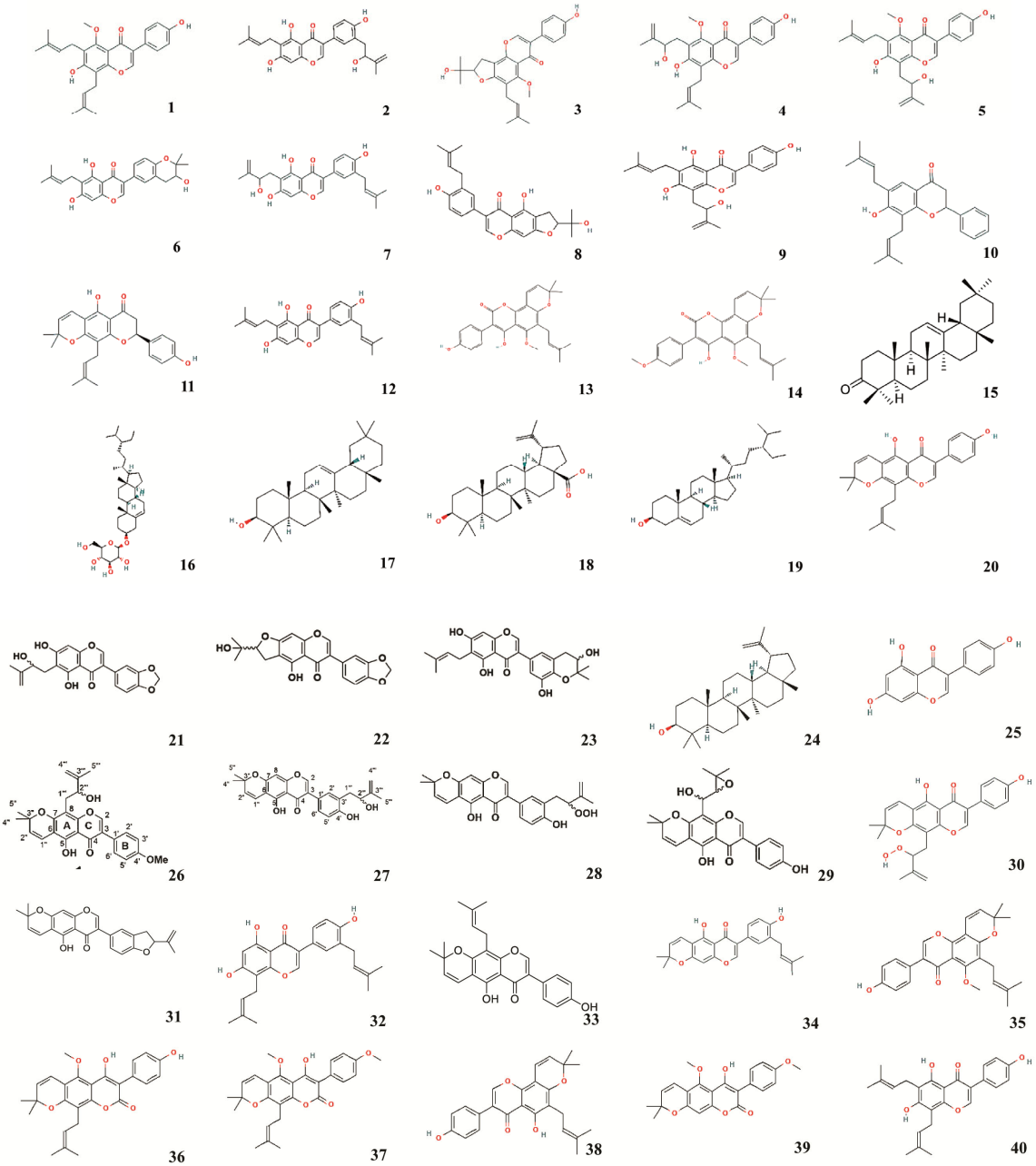

Fig. 1 — Chemical structure of phytochemical compounds isolated from different parts of *B. scandens*.

Table 2 — Anticancer activity of *B. scandens* on cell lines

S No	Plant part	Plant extract	Phytocompounds isolated	Cell line	References
1	Whole plant	Ethanolic extract	NPR	KKU-100, KKU-M139, KKU-M213, HepG2 and MCF-7	40
2	Stem	Ethanolic extract	NPR	HT-29	41
3	Stem	Ethanolic extract	NPR	Hep-2	42
4	Stem	Ethanolic extract	NPR	HT-29	43
5	Stem	Methanolic extract	Lupalbigenin	H460	24
6	Stem	Methanol extract	5,7,4-trihydroxy-6,8-diprenylisoflavone and lupalbigenin	KB, MCF-7 and NCI-H187	44
7	Whole plant	Ethanoilc extract	5,7,4′-Trihydroxy-6,8-diprenylisoflavone and lupalbigenin	MCF-7, MDA-MB-231 and MDA-MB-468, SW-620 L-929	45
8	Stem	Ethanolic extract	NA	HCC-S102	10
9	Leaves		derriscandenon A, B, and C	Epstein-Barr virus antigen (EBV-EA)	3
10	Flowers	Ethanolic extract	4′-*O*-Methylgrynullarin	PAN-1	46
11	Whole plant	Ethanolic extract	NA	HSC-2	47
12	Stem	Acetone extract	Derriscandenon D, E, F, G warangalone, millewanin E, rhynedlin A, 6,8-diprenylgenistein, isolupalbigenin, isoscandinone	A549, Colo205, KB, NALM-6, and human dermal fibroblasts	36
13	Stem	Ethanolic extract	17*β*-Estradiol, genistein, derrisisoflavone A, genistein-7-*O*-[*α*-rhamnopyranosyl-(1 → 6)-glucopyranoside, 6,8-diprenylgenistein, lupalbigenin]	MCF-7	21

NPR – No phytochemical reported

Table 3 — Anti-inflammatory activity of *B. scandens*

S No	Plant part	Chemical compound	Plant extract	Mode of action	Application	References
1	Stem	Genistein 7-*O*-α-rhamno(1→6)-β-glucosyl glycoside, 3′-γ,γ-dimethylallylweighteone and scandenin	Aqueous extract	Inhibited icosonoid production	NA	3
2	Leaf and roots	Ovaliflavanone and lupinifolin	Chloroform extract	Reduced paw thickness in Albino rats	Scientific validation of using the compounds as anti-inflammatory agent	24
3	Stem with mixtures of *Zingiber cassumunar* Roxb. (Z), *Suregadamultiflora* Baill. (S) and *Siphonodoncela strineus* (S)	NA	Ethanolic extract	Inhibitory effect on NO production in RAW 264.7 cells	A proof for further *in vivo* and clinical studies	48
4	Stem	Lupeol	Ethanolic extract	Strong 5-lipoxygenase inhibition	Analytical tool for quality control of *B. scandens* by quantifying lupeol compound	34
5	Stem	Lupalbigenin	Aqueous extract	Inhibits TNF-α, COX-2, iNOS, NF-κB	Scientific validation of using lupalbigenin as anti-inflammatory agent	49

(Contd.)

Table 3 — Anti-inflammatory activity of *B. scandens (Contd.)*

S No	Plant part	Chemical compound	Plant extract	Mode of action	Application	References
6	Stem	Genistein-7-O-[*α*-rhamnopyranosyl-(1 → 6)-*β*-glucopyranoside] (GTG) and lupalbigenin	Ethanolic extract	Reduced expression of IL-1α, IL-1*β*, IL-6, iNOS, COX-2, MMP-1, MMP-9, and Bax	Topical preparation against NB-UVB-induced inflammation, anti-aging, and prevention of skin cancer from phototherapy	50
7	Stem	Genistein-7-*O*-[*α*-rhamnopyranosyl-(1 → 6)]-*β*-glucopyranoside, genistein, derrisisoflavone A, lupalbigenin, and 6,8-diprenylgenistein	Ethanolic extract	Reduced expression of inducible nitric oxide synthase (iNOS), cyclooxygenase-2 (COX-2), interleukin-6 (IL-6), and 5-lipoxygenase (5-LOX)	Anti-inflammatory markers for the quantitative chemical analysis of *B. scandens*	21
8	Stem and leaves	isoangustone A and lupalbigenin, derrisisoflavone A and 6,8-diprenylgenistein, derrubone	Ethanolic extract	Inhibitory effect on NO production in RAW 264.7 cells	A proof for further *in vivo* and clinical studies	51

and putative antidiabetic activity was determined by *in-vitro* methods such as Glucose uptake by Yeast cells method, α-glucosidase inhibition activity assays. A dose dependent significant DPPH scavenging activity was found with three different plants when compared with standard drug ascorbic acid. The three plants leaf extracts exhibited a significant inhibitory action on α-glucosidase enzyme[53].

A recent study evaluated aqueous-ethanol extracts of *B. scandens* using both DPPH and FRAP. The water extract showed the highest FRAP activity: 762.46±47.95 µg/mL $FeSO_4$/g dried weight, whereas the 100% ethanol extract showed the lowest value, 253.04±3.47 µg/mL $FeSO_4$/g dried weight. The same study also isolated genistein -7-O-[α-rhamnopyranosyl-(1→6)]-β-glucopyranoside from *B. scandens*. The isolated compound showed FRAP activity of 34.23±2.75 mg $FeSO_4$ equivalents[54].

Antimicrobial activity

Different fractions of root and stem of *B. scandens* demonstrated good antibacterial (*Escherichia coli,* and *Bacillus megaterium*), antialgal (*Chlorella fusca*), and antifungal (*Microbotryum violaceum*) activities. Compounds such as scandenin, scandenin A, betulinic acid, lupeol, *β*-amyran-3-one, *β*-amyrin, *β*-sitosterol, and *β*-sitosterol glucopyranoside were isolated and checked for the antimicrobial efficiency of each compound. This study showed scandenin has strong antibacterial activity against *B. megaterium* and good antifungal and antialgal properties. Scandenin A showed good antibacterial, antifungal, and antialgal properties[11]. This strongly supports the antimicrobial effects of *B. scandens* extract.

Chaithanya and Seedevi[55] assessed the antibacterial activity of the ethanolic extract of *B. scandens* against clinically isolated human pathogenic bacteria by the agar well diffusion method. The ethanolic extract showed antibacterial activity against 8 clinical bacterial strains of the 10 pathogens tested. The effective bacterial inhibition rate of *B. scandens* indicates that it is a promising antibacterial agent against bacterial infections.

Shahriar *et al.*[56] evaluated the antimicrobial and membrane-stabilising potentials of methanol extracts of *B. scandens* leaf and stem, and their fractionates, using the agar-well diffusion method. The highest antimicrobial activity was observed against a Gram-negative bacterium (*E. coli*) by the methanol-soluble fraction of the leaf and stem extracts with 20 and 15 mm zones of inhibition, respectively. Other fractionates showed moderate antimicrobial and membrane-stabilising properties.

Wound-healing activity

Somwong *et al.*[36] investigated the wound healing activity of the *B. scandens* extract by checking the migratory property of Human Skin Fibroblasts when treated with the plant extract using a scratch wound assay. They revealed the potential wound-healing effects of two different extracts (50% and absolute ethanol) within 48 h of observation, along with control ascorbic acid.

Antidiabetic activity

Satla[57] used the yeast cell method and α-glucosidase inhibition activity experiments to show

the glucose absorption potency of *B. scandens* methanolic extract, together with two other plant species. The α-glucosidase enzyme was significantly inhibited by the leaf extracts of the three plants. The information gathered makes it abundantly evident that the plant extract can improve glucose uptake, which implies that it can also improve glucose utilisation, which in turn helps to regulate blood glucose levels.

Bhuiyan *et al.*[58] reported the hypoglycemic effects of methanolic extracts of *B. scandens* and *Thunbergia erecta* leaves in Swiss albino mice by using the *in vivo* method of oral glucose tolerance test. They measured the hypoglycemic effects of the extracts at doses of 200 and 400 mg/kg and recorded the percentage reduction of blood glucose levels in mice treated with both plant extracts. This study evidently proves the strong hypoglycemic effects of the *B. scandens* and *T. erecta* in the animal model.

Thrombolytic activity

Mukit *et al.*[26] reported that the petroleum ether soluble fraction of the stem of *B. scandens* exhibited substantial thrombolytic activity. The authors investigated the ability of the *B. scandens* fractions to break down blood clots *in vitro*. The fractions tested were petroleum ether, chloroform, ethyl acetate, and aqueous extracts. The assay was performed using human blood clot. Streptokinase was used as the positive thrombolytic control. The petroleum ether fraction showed the highest thrombolytic activity (27.94%) among the *B. scandens* fractions, although it was substantially less active than streptokinase (49.35%).

Insecticidal activity

Sreelatha *et al.*[59] isolated benzyl derivatives from the root extract of *B. scandens* and showed the compounds insect antifeedant efficacy and growth inhibitory studies using a no-choice laboratory bioassay, against the *Achaea janata* pest, which is a castor semilooper pest. In addition to being poisonous or causing developmental defects after topical application, several of the isolates demonstrated potent antifeedant activity.

Larval mortality was also observed in *B. scandens*. The findings of Rani *et al.*[60] demonstrated a similar effect and concluded that the death was caused by prenylated isoflavones found in *B. scandens*. Fumigation bioassays were utilised to assess the vapor-phase toxicity of components derived from *B. scandens* against four stored-product pests (*Callosobruchus chinensis* L., *Sitophilus oryzae* L., *Rhyzopertha dominica* L., and *Tribolium castaneum* H.) and compare the results to those of widely used pesticides. The test bug's sensitivity to the chemicals changed depending on the insect type, concentration, and duration of exposure. Compounds from *B. scandens* whole plant extract are promising candidates to control stored-product pests, according to the findings of fumigation testing.

Discussion

The systematic compilation of data on *Brachypterum scandens* highlights its profound significance in traditional medical systems and its emergence as a valuable reservoir of bioactive natural products. However, bridging the gap between traditional applications and modern phytopharmaceuticals requires a critical synthesis of the current state of research, an understanding of existing scientific limitations, and a clear vision for future explorations.

Phytochemical and pharmacological synthesis

Phytochemical investigations to date have established that *B. scandens* is enriched with diverse bioactive constituents, most notably prenylated isoflavonoids (such as *lupalbigenin*, *scandenin*, and *derrisisoflavones* A–F), flavonoids, coumarins, terpenoids, and phytosterols. The presence of these characteristic polyphenolic and lipophilic compounds directly underpins the major biological activities reported for the species.

Flavonoids and Antioxidant Efficacy: Flavonoids are powerful antioxidants that defend host cells against reactive oxygen species (ROS) and free radicals. The marked antioxidant capacity of plant-derived flavonoids in *B. scandens* is primarily mediated by their hydroxyl functional groups, which suppress ROS formation and chelate metal ions involved in free-radical generation[61].

Cytotoxic and Antitumorigenic potential: Flavonoids also contribute significantly to antitumorigenic activity by modulating different stages of cancer growth and development[62]. The cytotoxic effects observed across multiple cell line experiments (Table 2) highlight *B. scandens* as a promising candidate for anticancer research, though the exact underlying mechanisms require further elucidation.

Antimicrobial and Anti-inflammatory properties: Extract-based antimicrobial studies confirm strong

pathogen inhibition, supporting its prospective use in managing communicable diseases. Furthermore, the validated anti-inflammatory activity directly aligns with its traditional application in Thai and Ayurvedic medicine for managing musculoskeletal stiffness, osteoarthritis, and chronic pain. Key mechanisms include suppressing pro-inflammatory cascades (COX-2, 5-LOX, iNOS, and NFκB) and reducing the inflammatory capacity of immune cells[63].

Role of Terpenoids and Phytosterols: Beyond flavonoids, *B. scandens* contains structurally diverse terpenoids that act as phytoalexins, mediating defensive signaling. Additionally, phytosterols (structurally analogous to animal cholesterol) contribute to health benefits by competing with intestinal cholesterol absorption to lower blood cholesterol levels and mitigate coronary heart disease risks[64]. Phytosterols can also integrate into cancer cell membranes, altering intra- and extracellular signal transduction[65], while compounds like β-sitosterol protect cells against oxidative damage by enhancing endogenous antioxidant enzymes such as superoxide dismutase[66].

In plant medicine, therapeutic outcomes frequently arise from the harmonious, synergistic action across these distinct phytochemical classes—a principle that serves as the basis for traditional polyherbal formulations. Nevertheless, a critical analysis of the literature reveals significant scientific gaps that hinder its clinical translation.

Existing research gaps

Despite the promising bioactivities reported in literature, several fundamental scientific gaps remain unaddressed across both phytochemical and pharmacological domains.

Phytochemical and analytical gaps

Unexplored Plant Parts and Non-Targeted Metabolomics: Most phytochemical studies have focused heavily on stem and root extracts using targeted column chromatography. A comprehensive, non-targeted metabolomic profile (e.g., LC-MS/MS or NMR-based dereplication) for leaves, seeds, and minor plant parts is largely lacking, leaving potential minor bioactive metabolites uncharacterized.

Lack of Standardized Quality Control Protocols: There is a distinct shortage of validated, high-throughput analytical methods (such as HPLC-DAD or UPLC-QTOF-MS) for quantifying marker compounds (e.g., *lupalbigenin* and *derrisisoflavone* derivatives) across different seasonal harvests, geographical origins, and extraction methodologies.

Incomplete Structure-Activity Relationship (SAR) Data: Although several prenylated isoflavonoids have been isolated, systematic SAR studies exploring how specific prenyl, hydroxyl, or methoxy modifications influence biological efficacy and enzyme kinetics are missing.

Pharmacological, ADMET and toxicological gaps

Over-reliance on preliminary in vitro assays: A major proportion of reported bioactivities (including cytotoxic, antioxidant, and antimicrobial effects) remain confined to cell-line screening, lacking validation in complex *in vivo* disease models.

Absence of Pharmacokinetic and ADMET Profiling: Information regarding the Absorption, Distribution, Metabolism, Excretion, and Toxicity (ADMET) of isolated prenylated isoflavonoids is virtually non-existent. Due to their lipophilic nature, compounds like *lupalbigenin* likely suffer from poor aqueous solubility and rapid phase-II metabolism, yet no pharmacokinetic studies exist to evaluate their oral bioavailability.

Deficit in Comprehensive Safety & Clinical Data: Although *B. scandens* is included in the *Thai National List of Essential Medicines*, rigorous long-term toxicological evaluations (such as chronic toxicity, genotoxicity, and reproductive safety per OECD guidelines) and randomised, double-blind clinical trials remain sparse.

Future perspectives and strategic roadmap

To advance *B. scandens* from an ethnomedicinal resource to a standardised, evidence-based phytopharmaceutical or drug candidate, future research should follow a structured translational pipeline:

Advanced Chemical Fingerprinting and Standardization: Future studies should prioritise developing standardised chemical fingerprints (HPLC/UPLC) for extracts to ensure batch-to-batch consistency and raw material authentication in industrial manufacturing.

Network Pharmacology and Target Discovery: Applying *in silico* molecular docking, chem-proteomics, and network pharmacology can help map the multi-compound, multi-target networks of *B. scandens* extracts, shedding light on cross-talk mechanisms within inflammatory and apoptotic pathways.

Nanotechnology and Formulation Development: To overcome the poor aqueous solubility and bioavailability of prenylated flavonoids and sterols, research should explore Novel Drug Delivery Systems (NDDS)—such as nano-emulsions, solid lipid nanoparticles (SLNs), and liposomes—to optimize therapeutic delivery.

Pre-clinical Safety and Clinical Translation: Rigorous pre-clinical toxicity testing and well-designed Phase II/III clinical trials focused on osteoarthritis management, chronic pain relief, and supportive cancer therapy are necessary to satisfy global regulatory frameworks.

Conclusion

The existing literature confirms that *B. scandens* is a rich source of structurally unique secondary metabolites—notably prenylated isoflavonoids, flavonoids, coumarins, and phytosterols—that provide a strong biological rationale for its traditional use in managing inflammatory, musculoskeletal, infectious, and neoplastic conditions. However, to successfully transition this promising botanical species from ethnomedicinal use to standardised, evidence-based phytopharmaceuticals or clinical lead candidates. Further, this botanical drug warrants pharmacognostical standardisation, transition from *in vitro* screens to mechanistic *in vivo* models, pharmacokinetic and bioavailability optimisation and rigorous toxicological and clinical validation encompassing acute, sub-chronic, genotoxic, and reproductive safety profiles—must be systematically conducted. Finally, well-designed, randomised, double-blind, placebo-controlled clinical trials are required to unequivocally validate the efficacy and human safety of standardised *B. scandens* preparations for pain management and chronic inflammatory disorders. By addressing these core recommendations, future research will bridge the gap between traditional ethnomedicinal knowledge and modern evidence-based phytotherapy, fully unlocking the therapeutic and industrial potential of *B. scandens*.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AI use disclosure

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: During the preparation of this manuscript, the author(s) utilised generative AI technologies solely to improve language clarity, refine grammar, and assist with formatting and structural edits. After using these tools, the author(s) thoroughly reviewed, edited, and verified all content to ensure scientific accuracy and take full responsibility for the contents of the published article.

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