Bauhinia purpurea

Scientific Name

***Bauhinia purpurea* L.**

Synonyms

Bauhinia castrata Blanco, *Bauhinia coromandeliana* DC., *Bauhinia platyphylla* Span., *Bauhinia platyphylla* Zipp ex Span., *Bauhinia purpurea* L. var. *corneri* de Wit, *Bauhinia purpurea* L. var. *violacea* de Wit, *Bauhinia rosea* Corner, *Bauhinia triandra* Roxb., *Bauhinia violacea* Corner, *Caspareopsis purpurea* (L.) Pittier, *Phanera purpurea* (L.) Benth.

Family

Fabaceae also placed in Caesalpiniaceae

Common/English Names

Hawaiian Orchid Tree, Hong Kong Orchid Tree, Pink Butterfly Tree, Purple Butterfly Tree, Purple Camel's Foot, Purple Bauhinia, Purple Orchid Tree, Semki-Gona Gum

Vernacular Names

Afrikaans: Skoenlapperorgideeëboom
Burmese: Mahahlegani, swèý-tau ni
Chinese: Zi Yang Ti Jia, Yang Ti Jia
Eastonian: Purpur-sämplehik
French: Arbre À Orchidées, Bauhinia À Fleurs Pourpres, Bauhinie, Bauhinier
German: Purpurfarbener Orchideenbaum, Purpurrote Bauhinie, Schmetterlings-Bauhinie
India: Kanchanam (Andhra Pradesh), Kurial, Kanchan (Assamese), Devakanchan, Kanchan, Rakta Kanchan, Raktakanchan, Singyara (Bengali), Megong (Garo), Ashta, Gairal, Guiral, Gurial, Jhinjhora, Kachnar, Kaliar, Kandan, Kaniar, Karal, Karial, Khairwal, Koilari, Koinar, Koliar, Kwiryal, Lal Karal, Makkuna, Mawai, Lal Kachnar, Sona (Hindi), Arelu, Akilu, Banne, Basavanapadu, Deva Kaanchana, Kanchivaala, Kanchivala, Kanchuvaala, Kancivala, Kanjivala, Kempu Kanchuvaala, Kempu Mandaara, Kempukanchavala, Kempukancivala, Kempukanjivala, Kempumandara, Kempu Kanchivaala, Kempumandaara, Mandara, Sarul, Uleppe, Ulipe (Kannada), Dieng Long (Khasi), Chovanna-Mandaru, Chovannamandaru, Cuvannamandaram, Mandaram, Suvannamandaram (Malayalam), Chingthao Angangba (Manipuri), Atmatti, Kanchan, Dev Kanchan, Deva, Devana Kanchana, Kanchana, Ragtachandan, Ragthachandan,Rakta Kanchan, Raktha Kaanchan, Tambdo-Apto (Marathi), Vaube, Vaufavang (Mizoram), Borodo, Vaube (Oriya), Camarikah, Kancanarah, Kanchan, Kovidara, Kovidarah, Mahayamalapatrakah, Raktakovidara, Raktapushpakovidara, Swetakancanara, Tamrapuspah, Vanaraja (Sanskrit), Acanomantarai, Acanomantaraimaram, Acuvacam-

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purappu, Arputaveni, Atthi, Cikappu Mantarai, Compucikam, Compucikamaram, Kalavilaccai, Kalavilaichi, Kalarviluti, Kalaviluti, Karuppumantarai, Kattu Mantarai, Mancaltarai, Mancaltaraimaram, Mandarai, Mandari, Mandareh, Mandharai, Mantarai, Mantharai, Mutiraikkali, Nilataru, Nilattiruvatti, Periyavatti, Punkaram, Purapicam, Segappumandarai, Ulittikam (Tamil), Aroe,Bodanta, Bodanta Chettu, Deva-Kasla, Devakaanchanamu, Devakanjanamu, Kaanchanamu,Kanchanam, Kanjanamu, Peddaare, Peddare, Peddari (Telugu)

Indonesia: Bunga kupu-kupu (Malay), suwoto (Javanese), Aroy kupu-kupu (Sundanese)

Japanese: murasaki mokuwan-ju

Malaysia: Tapak Kuda (Peninsular), lupit (Sabah), daun tangkop bedaup (Iban, Sarawak), akah punan, dakun punan, urok punan (Kayan, Sarawak), dahup dahup (Kedayan, Sarawak), ikop (Penan, Sarawak), babayak (Selako, Sarawak)

Nepal: Khwairalo, Koeralo, tanki

Philippines: Alibang-bang (Tagalog)

Portuguese: Pie De Cabra

Singapore: Tapak Kuda

Spanish: Palo De Orquídeas, Pie de cabra

Sri Lanka: Kolar

Swedish: purpurbauhinia

Thai: Chong Kho; Seaw Dok Dang, Sio Dak Dang sieowaan, sieo dok daeng

Tibetan: Go Bi Da Ra, Ko Bi Da Ra, Ko Bid Dri

Vietnamese: Mòng bò tím; Móng bò hoa đỏ; Mòng bò lan

Origin/Distribution

The species is native to South China (which includes Hong Kong), Pakistan, India and Myanmar, southern China, Philippines and Northern Australia.

Agroecology

A tropical/subtropical species but the plant is frost hardy and light demanding. It thrives in well-drained, loamy soils in areas with 500–2,774 mm or more annual rainfall with no dry season and with temperatures of 9–37 °C. It will survive temperatures of −4 or −5 °C. It grows from above sea level to 2,000–3000 m altitude. In its native range it occurs at lower elevations. It has escaped from cultivation and has naturalized in many tropical countries and occurs in savanna, scrub and dry deciduous forest to swamp forest evergreen lowlands, rain forest to mountain forests.

Edible Plant Parts and Uses

The leaves, flower buds, flowers and young pods are eaten as vegetable and pot herb. The flower and buds are often used in curries and pickles and as condiments (Burkill 1966). The flower buds are cooked and eaten as vegetables in Andhra Pradesh (Reddy et al. 2007) and Uttarakhand Himalaya (Namrata et al. 2011). In Thailand, young shoots and leaves are added in curry dishes; the taste is somewhat sour (Jircas 2010). The young pods and mature seeds of kachnar are known to be cooked and eaten by tribes such as the Kathkors and Gondas of India (Rajaram and Janardhanan 1991).

Botany

A shrub to small tree from 4 to 10 m high with grey to dark brown bark (Plate 1) and pubescent young aerial parts. Leaves petiolate, petiole 2.5–5 cm long, lamina 4.5–11 cm long, 4.5–10 cm wide, 9–11 nerved, cleft about halfway down into 2 acute or rounded lobes, minutely pubescent below when young (Plates 1 and 2). Inflorescence few-flowered panicles at the ends of the branches. Flowers on 5–13 mm long pedicels; tomentose, bract 3 mm long, bracteole 2 mm long, pale purple or at least purple-marked and fragrant (Plates 3 and 4). Hypanthium 7–10 mm long. Calyx 2.5–3.0 cm long, usually splitting into two reflexed segments, one emarginate the other 3 toothed. Petals 3.7–5 cm long, oblanceolate, long clawed, spreading, veined. Stamens usually 3 fertile with versatile anthers, staminodes 7. Ovary

Plate 1 Leaves and trunk of *B. purpurea*

Plate 2 Leaves and flower buds

Plate 3 Flowers and foliage

downy, long stalked; style long, stigma oblique. Pod 15–30 cm long by 1.5–2.5 cm broad, flat green on 2 cm long stalk and containing 12–15 seeds. Seed almost round, 1.2–1.3 cm across, brown and smooth.

Plate 4 Close-up of flower

Nutritive/Medicinal Properties

Flower Phytochemicals

The aqueous methanol extract of fresh flower afforded the flavonoid quercetin and flavonoid glycosides isoquercitin, astragalin, kaempferol-3-glucoside, pelargonidin-3-glucoside and 3-triglucoside (Ramchandra and Joshi 1967). The flower volatile oil was found to have monoterpenes α-terpinene, limonene, myrcene, linalool, citronellyl acetate; and a phenylpropanoid (eugenol) (Wassel et al. 1986).

Leaf Phytochemicals

The following flavonoids quercetin, rutin, quercitrin, apigenin and apigenin-7-*O*-glucoside were from the leaves (Abd-El-Wahab et al. 1987). The leaves were found to have diglucosides of quercitrin, kaempferol and isorhamnetin (Salatino et al. 1999).

A mixture of phytol fatty esters (1a, 1b, 1c, 1d, 1e, 1f), lutein, and B-sitosterol was isolated from the leaves (Ragasa et al. 2004). The two dimeric flavonoids, namely, bis [3′,4′-dihydroxy-6-methoxy-7,8-furano-5′,6′-monomethylalloxy]-5-C-5-biflavonyl and (4′-hydroxy-7-methyl 3-C-α-L-rhamnopyranosyl)-5-C-5-(4′-hydroxy-7-methyl-3-C-α-D-glucopyranosyl) bioflavonoid with protein-precipitating property, were isolated from 70 % aqueous acetone extract of *B. purpurea*

leaves (Yadav and Bhadoria 2005). An ursane triterpene α-amyrin caprylate was isolated along with other triterpenoids from petroleum ether fraction of ethanolic extract (95 %) of the leaf of *Bauhinia purpurea* (Verma et al. 2009).

Leaves of *B. purpurea* were found to have anti-nutrient factors: condensed tannins (195.0 mg/g) with protein-precipitating capacity (7.438 mg BSA (bovine serum albumin)/g) and protein-precipitable phenolics (64.94 %) (Yadav and Bhadoria 2001).

Stem/Bark/Wood Phytochemicals

A 6-butyl-3-hydroxyflavanone elucidated 6-(3″-oxobutyl)taxifolin and 3 glycerol derivatives 2, 3-dihydroxypropyl oleate, 2,3 dihroxypropyl linoleate, and 2,3- dihydroxypropyl 16-hyroxy-decanoate were isolated from the heartwood (Kuo et al. 1998). A flavone glycoside 5, 6-dihydroxy-7-methoxyflavone 6-*O*-β-D-xylopyranoside was isolated from the chloroform-soluble fraction of the ethanol extract of the stem (Yadava and Tripathi 2000).

Root Phytochemicals

The dichloromethane extract of root of *B. purpurea* yielded 11 secondary metabolites comprising eight dihydrodibenzoxepins, namely, bauhinoxepin C–J; a dihydrobenzofuran, bauhinobenzofurin A; a novel spirochromane-2,1′-hexenedione, bauhispirorin A; a new bibenzyl bauhinol E; two flavanones (−)-strobopinin and demethoxy-matteucinol and five known bibenzyls which possessed various pharmacological activities, namely, antimycobacterial, antimalarial, antifungal, cytotoxic and antiinflammatory activities (Boophong et al. 2007).

Seed Phytochemicals

Chalcone glycosides, butein 4′-*O*-β-L-arabinopyranosyl-*O*-β-D-galactoside (Bhartiya et al. 1981) and 3,4-dihydroxychalcone 4-*O*-β-L-arabinopyranosyl-*O*-β-D-galactopyranoside (Bhartiya and Gupta 1981) were isolated from the seeds. *N*-hexane extract of kachnar oilseeds was found to be 17.5 % (Ramadan et al. 2006). The amount of neutral lipids in the crude *B. purpurea* seed oil was the highest (about 99 % of total lipids), followed by glycolipids and phospholipids. Linoleic followed by palmitic, oleic and stearic were the major fatty acids in the crude seed oil and its lipid classes. The oil was characterized by a relatively high amount of phytosterols β-sitosterol and stigmasterol. β-tocopherol was the major tocopherol isomer with the rest being δ-tocopherol. A flavone glycoside was isolated; glycoside-6-4′-diahydroxy-3′-prenyl-3,7,5,7′-tetramethoxy flavone-6-*O*-α-L-rhamnopyranoside was isolated from the acetone-soluble faction of the seed ethanolic extract of *B. purpurea* (Yadav and Sodhi 2001).

The seeds of *B. purpurea* and *B. vahlii* contained higher contents of crude protein and crude lipid than those of *B. racemosa* resulting in higher energy values for these two pulses (Rajaram and Janardranan 1991). The seeds of *B. purpurea* were rich in K, whereas those of *B. racemosa* and *B. vahlii* were rich in Ca and Fe. Albumins and globulins constituted the predominant fractions of the seed proteins in *B. purpurea* and *B. vahlii,* whereas glutelins predominated in *B. racemosa*. In all three species the contents of the essential amino acids lysine, tyrosine and phenylalanine were fairly high; the contents of sulphur amino acids were limiting. Isoleucine and leucine were limiting only in *B. vahlii* proteins. Levels of anti-nutritional factors such as free phenols, tannins, L-DOPA and haemagglutinating and trypsin inhibitor activities were not particularly high.

Raw *B. purpurea* seeds were found to contain anti-nutrient factors (per 100 g): total free phenolics 2.75 g, tannins 2.35 g, phytic acid 692 mg and flatulence factors, raffinose 0.54 g, stachyose 1.17 g and verbascose 0.95 g (Vijayakumari et al. 2007). Soaking the seeds in distilled water caused maximum reduction in the phytic acid content (37 %), whereas soaking in $NaHCO_3$ solution reduced significant levels of phenolics and tannins (72 % and 78 %, respectively). Cooking reduced the levels of oligosaccharides (raffinose by 63 %,

stachyose by 42 % and verbascose by 79 %). Of the attempted treatments, autoclaving appeared to be most effective in reducing levels of all the investigated anti-nutrients, except phytic acid, and also improved the in-vitro protein digestibility of *B. purpurea* seeds.

Plant Phytochemicals

Four dibenz[b,f]oxepins (2a, 3–5) named bauhiniastatins 1–4 and related pacharin were isolated from the leaves, stems, pods and roots (Pettit et al. 2006).

Antioxidant Activity

Studies showed that the methanol plant extract of *Bauhinia purpurea* was more effective in scavenging free radical activity than the petroleum ether and ethyl acetate extracts in all the antioxidant tests (Shajiselvin and Muthu 2011). Maximum chelating of metal ions at 1,000 µg/ml for methanol extract was 77.56 % compared to petroleum ether extract 48.27 %, ethyl acetate extract 59.61 % and EDTA 97.90 %. The respective IC_{50} values were 270, 1,030, 610 and 65 µg/ml for EDTA. Maximum total antioxidant activity (using the phosphomolybdic acid method) at 1,000 µg/ml for the methanol extract was 72.46 % compared to petroleum ether extract 41.61 %, ethyl acetate extract 65.70 % and ascorbate 55.23 %. The respective IC_{50} values were 55.23, 490, 1,250 and 410 µg/ml for ascorbate. Maximum reducing ability (FRAP) at 1,000 µg/ml for the methanol extract was 77.98 % compared to petroleum ether extract 37.67 %, ethyl acetate extract 58.50 % and ascorbate 98.07 %. The respective IC_{50} values were 290, 580, 1,430 and 50 µg/ml for ascorbate. The ethanol leaf extract (95 % v/v) exhibited significant free radical scavenging activity and reducing power activity when compared with ascorbic acid (Joshi et al. 2009). The IC_{50} values were determined to be 78.31 and 59.37 µg/ml for the ethanol leaf extract and ascorbic acid, respectively.

The aqueous and methanol, but not chloroform, extracts of *B. purpurea* leaves (20, 100 and 500 µg/ml) exhibited concentration-dependent antioxidant activity only in the superoxide scavenging assay but low to moderate activity in the DPPH radical scavenging assay, which could be associated with their total phenolic contents (Zakaria et al. 2011b). Soxhlet-extracted (SBE), ultrasonicated (UBE) and macerated (MBE) *B. purpurea* leaf extracts exhibited good DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS (2,2-azinobis (3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt) radical scavenging as well as potential reducing ability in total antioxidant capacity (TAC) and FRAP (ferric-reducing antioxidant power) methods (Annegowda et al. 2012). UBE possessed significant radical scavenging activity and reducing ability and polyphenolic constituents followed by MBE and SBE.

Anticancer Activity

Bauhiniastatins 1–4 isolated from various *B. purpurea* plant parts were found to be cancer cell growth inhibitors (Pettit et al. 2006). They exhibited significant growth inhibition against a minipanel of human cancer cell lines, and bauhiniastatin 1 was also found to inhibit the P388 (lymphocytic leukaemia) cancer cell line. Among the secondary metabolites isolated from roots, compounds bauhinoxepin C (1), bauhinoxepin D (2), bauhinoxepin F (4), bauhinoxepin H (6), bauhinoxepin I (7), bauhinoxepin J (8) and a known bibenzyl (18) exhibited cytotoxicity towards KB (nasopharyngeal carcinoma) and BC (breast cancer) cell line with IC_{50} values ranging from 10.5 to 72.3 µM (Boophong et al. 2007). The aqueous and chloroform leaf extracts of *B. purpurea* significantly inhibited in-vitro the proliferation of all cancer cells while the methanol extract inhibited the proliferation of most cancer cells except the leukaemic CEMss cells when assessed using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay (Zakaria et al. 2011b). The aqueous extract was effective against human breast cancer lines MCF-7 (IC_{50}=9 µg/ml) and MDA-MB 231

(IC_{50} = 17 μg/ml) and ovarian cancer Caov-3 (IC_{50} = 16 μg/ml); the chloroform extract was highly effective against the CEMss (IC_{50} = 18 μg/ml) and cervical cancer HeLa (IC_{50} = 21 μg/ml) cell lines; and the methanol extract was highly effective only against the HL-60 (= 12 μg/ml) cell lines. All the extracts did not inhibit proliferation of 3 T3 cells suggesting their non-cytotoxic properties.

Antiinflammatory Activity

The aqueous leaf extract of *Bauhinia purpurea* exhibited antiinflammatory activity in the carrageenan-induced paw oedema in rats (Zakaria et al. 2007). The chloroform leaf extract of *B. purpurea* exhibited significant antiinflammatory activity in rats in a non-concentration-dependent manner in the carrageenan-induced paw oedema test (Zakaria et al. 2009). Unexpectedly, the 100 mg/kg extract showed a less remarkable antiinflammatory activity compared to the other doses tested. The chloroform extract of *B. purpurea* was found to contain bioactive flavonoids, saponins, triterpenes and steroids but no alkaloids and tannins. The methanol stem bark extract (300 mg/kg) exhibited antiinflammatory activity as evaluated by the carrageenan induced rat paw oedema, but its activity was lower than the standard drug, diclofenac (Chandrashekar et al. 2009b).

Among the secondary metabolites isolated from roots, compounds bauhinoxepin F (4) and bauhinoxepin I (7) possessed potent antiinflammatory activity inhibiting the COX-2 enzyme with IC_{50} value of 6.9 and 10.1 μM, respectively (Boophong et al. 2007). Ethanol stem extract of *Bauhinia purpurea* displayed significant antiinflammatory activity as determined by carrageenan-induced paw oedema using plethysmometer in albino rats (Shreedhara et al. 2009). Ethanol root extract of *B. purpurea* administered to rats at doses of 200, 400 mg/kg body weight produced significant antiinflammatory activity in the carrageenan-induced paw oedema model and cotton pellet granuloma pouch method (Pais et al. 2012).

Nephroprotective Activity

Studies showed that the ethanol extract of leaves and unripe pods of *B. purpurea* possessed potent nephroprotective activity against gentamicin-induced toxicity in rats (Lakshmi et al. 2009). Gentamicin-induced glomerular congestion, blood vessel congestion, epithelial desquamation, accumulation of inflammatory cells and necrosis of the kidney cells were found to be reduced in the groups receiving the leaf and unripe pods extract of *Bauhinia purpurea* along with gentamicin. The extracts also normalized the gentamicin-induced increase in serum creatinine, serum uric acid and blood urea nitrogen levels. This was also confirmed by the histopathological studies.

Anti-hypothyroidism Activity

Studies showed that daily administration of *B. purpurea* bark extract (2.5 mg/kg body wt.) to female mice for 20 days increased serum triiodothyronine (T3) and thyroxine (T4) concentrations (Panda and Kar 1999). The extract elicited an increase in hepatic glucose-6-phosphatase (G-6-Pase) activity and antiperoxidative effects as indicated either by a decrease in hepatic lipid peroxidation (LPO) and/or by an increase in the activity of antioxidant enzyme. The results suggested that the plant extract was capable of stimulating thyroid function in female mice.

Recent studies found that *B. purpurea* plant extract has the potential to ameliorate metformin-induced hypothyroidism in type 2 diabetic animals (Jatwa and Kar 2009). The researchers reported that dexamethasone (1.0 mg/kg, i.m.) administration caused hyperglycaemia with a parallel increase in renal lipid peroxidation (LPO), relative risk ratio (RR) and the concentrations of serum insulin, total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C) and triglycerides (TG). Dexamethasone decreased serum triiodothyronine, thyroxine and high-density lipoprotein cholesterol (HDL-C) levels as well as renal superoxide dismutase (SOD), catalase (CAT) and reduced glutathione (GSH) content. Oral administration

with metformin (150 mg/kg) to dexamethasone-induced diabetic animals reduced renal lipid peroxidation (LPO), relative risk ratio, serum concentrations of insulin, glucose and low-density lipoprotein cholesterol (LDL-C) with a parallel increase in cellular antioxidants, but it further reduced circulating thyroxine level and caused severe hypothyroidism. Oral administration with either *Withania somnifera* (1.4 g/kg) or *Bauhinia purpurea* (2.5 mg/kg) extract along with dexamethasone and metformin elevated the concentrations of circulating triiodothyronine and thyroxine to euthyroid level. The plant extracts also corrected relative risk ratio and serum lipid concentration.

Antimicrobial Activity

The mixture of phytol fatty esters, sillated from the leaves, was found to have low activity against the fungi *Aspergillus niger* and *Candida albicans* and inactive against the bacteria *Psuedomonas aeruginosa, Staphylococcus aureus*, *Bacillus subtilis and Escherichia coli* and the fungus, *Trichophyton mentagrophytes* (Ragasa et al. 2004). The isolated secondary metabolites, isolated from roots, exhibited antimycobacterial activity with MIC values ranging from 24.4 to 740.7 μM. Among all compounds bauhinoxepin J was the most potent antimycobacterial agent having a MIC value of 24.4 μM (Boophong et al. 2007).

Among the secondary metabolites isolated from roots, compounds bauhinoxepin C (1), bauhinoxepin F (4), bauhinobenzofurin A (9), 2 known bibenzyls (15) and (18) exhibited antifungal activity (IC_{50} 49.6–130.1 μM) (Boophong et al. 2007). Soxhlet-extracted (SBE), ultrasonicated (UBE) and macerated (MBE) *B. purpurea* leaf extracts exhibited antibacterial activity, with UBE inhibiting most of the bacteria followed by MBE and SBE (Annegowda et al. 2012).

Antiulcerogenic Activity

Oral administration of the aqueous leaf extract of *B. purpurea* to rats was found to have antiulcerogenic activity in a dose-dependent manner (Zakaria et al. 2011a). The extract at the dose of 5,000 mg/kg did not cause any signs of toxicity to rats. Histological studies supported the observed antiulcer activity of the extract. Further the extract increased gastric wall mucus secretion. The results supported the traditional uses of *Bauhinia purpurea* in the treatment of ulcers.

CNS (Central Nervous System) Activity

The aqueous leaf extract of *Bauhinia purpurea* exhibited antinociceptive activity in mice in the abdominal constriction, hot plate and formalin tests (Zakaria et al. 2007). The chloroform leaf extract of *B. purpurea* was found to possess significant, but concentration-independent, antinociceptive activity in mice when assessed using the abdominal constriction and hot-plate test (Zakaria et al. 2009). Ethanol root extract of *B. purpurea* administered to rats at doses of 200, 400 mg/kg body weight exhibited antinociceptive activity in the tail flick and acetic acid-induced writhing tests (Pais et al. 2012). Ethanol stem extract of *Bauhinia purpurea* exhibited significant analgesic activity as evaluated by the Eddy's hot-plate and acetic acid writhing animal models (Shreedhara et al. 2009). The ethyl acetate stem bark extract (400 mg/kg) exhibited analgesic activity as tested by acetic acid-induced writhing model and hot plate method (Chandrashekar et al. 2009a).

Hepatoprotective Activity

Studies showed that the aqueous, alcoholic and chloroform leaf extracts of *B. purpurea* exhibited hepatoprotective effects against carbon tetrachloride-induced hepatotoxicity in albino Wistar rats (Veena Rani et al. 2011). All the extracts dose-dependently lowered the elevated levels of alkaline phosphatase (ALP), serum glutamic pyruvic transminase (SGPT) serum glutamic oxaloacetic transaminase (SGOT), total protein (TP), acid phosphatase (AP) total bilirubin (TB) and direct bilirubin (DB) induced

by carbon tetrachloride . This was confirmed by histopathological studies. The hepatoprotective activity of the extract was ascribed to its good antioxidant activity. In another study, the results of in-vivo experiments showed that the water bark extract of *B. purpurea* inhibited lipid peroxidation, protected the experimental animals from alcohol-induced hepatic toxicity in rats and maintained the levels of antioxidants in a dose-dependent manner (Chaturvedi et al. 2011). Both methanol and water bark extracts scavenged free radicals equivalent to gallic acid scavenging and were found rich in total phenol content.

Wound Healing Activity

In the excision and burn wound models, rats treated with high doses of methanol and chloroform leaf extracts of *Bauhinia purpurea* showed significant reduction in time taken for epithelialization and wound contraction (50 %) compared to control (Ananth et al. 2010). A significant increase in breaking strength was found in incision wound model with methanol and chloroform extracts compared to their respective carbopol and simple ointment bases. In the dead space wound model, methanol and chloroform extract treatment (100 and 500 mg/kg) orally produced a significant increase in the breaking strength, dry tissue weight and hydroxyproline content of the granulation tissue when compared to control. Among the extracts, methanol extract exhibited more activity followed by the chloroform extract. The study indicated that *Bauhinia purpurea* leaves exhibited wound healing activity.

Antidiabetic Activity

The ethanol stem extract of *B. purpurea* and its fraction-1 exhibited antidiabetic activity in alloxan-induced diabetic rats, as evident from the serum glucose levels (Muralikrishna et al. 2008). The hypoglycaemic activity may be ascribed to the presence of flavonoids. Oral treatment of the ethanol flower leaf and root extracts of *B. purpurea* at doses of 100, 200, 400 mg/kg for 15 days exhibited significant antidiabetic activity in streptozotocin-induced diabetic rats by reducing and normalizing the elevated fasting blood glucose levels as compared to those of streptozotocin control group (Prasanna and Shastry 2012).

Cardiotonic Activity

The F1 fraction of the ethanol stem extract of *B. purpurea* exhibited excellent adrenergic activity (10 mg/ml) in isolated frog's heart (Muralikrishna et al. 2008). This was further confirmed as its action was blocked by an adrenergic β_2-blocker (propranolol) in isolated frog heart. The cardiotonic activity exhibited by the fraction-1 was probably due the presence of flavonoids. The results suggested that the fraction-1 exhibited positive inotropic and chronotropic effect on an isolated frog's heart.

Antipyretic Activity

The aqueous leaf extract of *Bauhinia purpurea* exhibited antipyretic activity in rats in the brewer's yeast-induced pyrexia test (Zakaria et al. 2007).

Anti-diarrhoeal Activity

The ethanol leaf extract of *B. purpurea* exhibited significant anti-diarrhoeal activity in two animal models, viz. castor oil-induced diarrhoea in rats and gastrointestinal motility test by using charcoal meal compared to the control group (Mukherjee et al. 1998).

Antimalarial Activity

Among the secondary metabolites isolated from roots, compounds bauhinoxepin H, bauhinoxepin I, bauhinoxepin J and a known bibenzyl exhibited antimalarial activity with IC_{50} values 5.8–11.2 μM (Boophong et al. 2007).

Immunological Activity

Bauhinia purpurea lectin (BPA), a galactose- and lactose-binding lectin, was found to have nine amino acids and the amino acid sequence: aspartic acid, threonine, tryptophan, proline, asparagine, threonine, glutamic acid, tryptophan and serine (Yamamoto et al. 1991). Studies showed that a chimeric lectin with unique carbohydrate-binding specificities could be formed *Bauhinia purpurea* lectin (BPA) and Lens culinaris lectin (LCA) (Yamamoto et al. 2000). The chimeric lectin can be constructed from BPA by substituting several amino acid residues in its metal-binding region with other amino acid residues from LCA, providing a powerful tool for biochemical, immunochemical and histochemical studies. *Bauhinia purpurea* agglutinin (BPA) a Galbeta1-3GalNAc (T)-specific leguminous lectin had been widely used in multifarious cytochemical and immunological studies of cells and tissues under pathological or malignant conditions (Wu et al. 2004). This lectin possessed a binding specificity to dense cell surface Galbeta1-3GalNAc (T), high-density polyvalent GalNAcalpha1-Ser/Thr (Tn) and Galbeta1-3/4GlcNAc (I/II) glycoconjugates facilitating its future use in biotechnological and medical applications.

Anthelmintic Activity

The aqueous and ethanol *B. purpurea* plant extracts exhibited significant anthelmintic activity at highest concentration of 100 mg/ml against *Pheretima posthuma* (Kumar et al. 2011).

Traditional Medicinal Uses

The bark, root, leaves and flowers of *Bauhinia purpurea* are reputed to have medicinal properties and used in traditional folk medicine in India, Pakistan, Sri Lanka and Malaysia (CSIR 1948; Chopra et al. 1956; Burkill 1966). Flowers are laxative and are used as a purgative in Pakistan, while the leaves are applied externally to the forehead to treat fever. The leaves contain tannin and are used for poulticing sores and boils in Malaysia and India. The dried buds are used in the treatment of piles, dysentery, diarrhoea and worms. In India the bark is used for poulticing treatment of skin diseases, scrofula and ulcers stomach tumour and wounds. A decoction of the bark is taken for diarrhoea. The root is used as an antidote to snake poison and decoction of the root used for dyspepsia.

In Sarawak, Malaysia, the Ibans consume a tea made from the roots for high blood pressure, stomachache and diarrhoea (Chai 2006). Pounded leaves are rubbed on the back to alleviate backache. The Kayan take the root decoction for cough, stomachache and diarrhoea and the solution used as gargle for toothache. The Kedayan boiled the root with fennel and shallot and drink the decoction for stomach-ache and diarrhoea. The Penan drink the root decoction for toothache. The Selako boil the leaves with sea weed and sea shells and drink the decoction to relieve kidney problems and pain when urinating.

B. purpurea have been used to treat stomach tumours, ulcers, wounds, glandular swellings, diarrhoea and fever in traditional medicine (Zakaria et al. 2007). *B. purpurea* known to the Malays as 'pokok tapak kerbau' has been traditionally used by the Indian, Sri Lankan and Pakistani people to treat ailment like ulcer, wound, glandular swelling and stomach tumour. The decoction of the root is used for expelling gases, flatulence and griping pain from the stomach and bowel; the bark of the plant is used as an astringent in the treatment of diarrhoea. Its decoctions are recommended as a useful wash solution for ulcers. Decoction of *B. purpurea* stem administered twice a day as folk remedy was found to be effective against asthma and other respiratory disorders (Patil et al. 2008) The bark or root and flower mixture with boiled rice water is used as maturant for boils and abscesses (Kurian 2004). The decoction of flower is used as a laxative (Wassel et al. 1986). Fresh bark of Kaanchanaara (*B. purpurea*) mixed with Shunthi (dry *Zingiber officinale*), pounded with sour gruel, was prescribed in enlarge cervical glands (Vrindamaadhava) as well as in goitre (Shaarangadhara Samhitaa, Bhavaprakaasha). Over the counter Kaanchanaara

(*B. purpurea*) Guggulu (Shaarangadhar Samhitaa) is used to treat enlarge cervical glands, goitre and scrofulous tumours. The roots are used as carminative and flower buds as laxative and anthelmintic in folkloric medicine in Mangalore, India (Shiddamallayya et al. 2010). Bark sap with honey is taken against leucorrhoea and is also used to treat menstrual problems in Assam (Das et al. 2008).

Other Uses

The plant is often cultivated as an ornamental, roadside, garden plant and shade tree. It is also used for soil improvement and erosion control. The leaves, pods and shoots are used as fodder. The stem yields semki-gona gum and the bark is good as tanning material, dyeing and for fibre. The wood is used for making furniture, agricultural implement and for house building and fuel.

Comments

Bauhinia purpurea can be grown from seeds, stem cuttings or by air layering.

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