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_Bauhinia purpurea_ Linn.: A Review of its Ethnobotany, Phytochemical and Pharmacological Profile

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ABSTRACT

The use of natural products as medicinal agents presumably predates the earliest recorded history. _Bauhinia purpurea_ is a species of flowering plant is used in several traditional medicine systems to cure various diseases. This plant has been known to possess antibacterial, antidiabetic, analgesic, anti-inflammatory, anti-diarrheal, anticancerous, nephroprotective and thyroid hormone regulating activity. A wide range of chemical compounds including 5,6-Dihydroxy-7-methoxyflavone 6-O-β-D xylopyranoside, 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) biflavonoid, bibenzyls, dibenzooxepins, mixture of phytol fatty esters, lutein, β-sitosterol, isoquercetin and astragalin etc. The present review discusses phyto-chemistry, pharmacology, medicinal properties and biological activity of _B. purpurea_ and its usage in different ailments.

Key words: _Bauhinia purpurea_, pharmacology, phyto-chemistry

INTRODUCTION

Nature has provided a complete storehouse of remedies to cure ailment of mankind. Medicinal plants have been used for centuries as remedies for disease because they contain component of therapeutic values. According to the WHO, 80% of the world population continues to rely mainly on traditional medicines for their health care (WHO, 1993). Herbal medicines, as the major remedy in traditional medical systems, have been used in medical practice for thousands of years and have made a great contribution to maintaining human health. A majority of the world’s population in developing countries still relies on herbal medicines to meet its health needs. The attention paid by health authorities to the use of herbal medicines has increased considerably, both because they are often the only medicine available in less developed areas and because they are becoming a popular alternative medicine in more developed areas (Gurib-Fakim, 2006). The continued investigation into the secondary plant metabolites has gained importance for their safe use.

GEOGRAPHICAL DISTRIBUTION

_Bauhinia purpurea_ L. is a medium sized deciduous tree belongs to the family Leguminosae (Caesalpinioideae), native to South China (which includes Hong Kong) and Southeastern Asia and it is found throughout India, ascending to an altitude of 1300 m in the Himalayan (Khare, 2004).
B. purpurea is a moderate evergreen tree in sub-Himalayan region and western track of India and often its leaves are used as fodder during the lean period (Jha, 1995). The genus Bauhinia, consisting of 300 species (Chopra et al., 1996). In the United States of America, the tree grows in Hawaii, coastal California, southern Texas and southwest Florida. Common names include Hong Kong Orchid Tree, Purple camel’s foot and Hawaiian orchid tree.

Plant profile: It is a small to medium-sized deciduous tree growing up to 17 m tall. The bark is ashy to dark brown, nearly smooth, young parts brown-pubescent. The leaves are 7.5-15 cm long, rather than longer than broad, cleft about half way down into 2 acute or rounded bilobed very minutely pubescent beneath when young, base usually cordate, 9-11 nerved; petiole 2.25-3.8 cm long. The flowers are conspicuous, pink and fragrant with five petals. Pedicels 5-13 mm long, stout, tomentose, bract and bracteoles small tomentose, deltoid. Calyx tomentose, tube 7.5-10 mm long, limb long as the tube. Petals 3.8 to 5 cm long, ob lanceolate, long clawed, spreading veined. Stamens usually 3 fertile, others reduced to antherless filaments. Ovary downy, long-stalked; style long; stigma large, oblique. Pod 15-25 by 1.5-2 cm on a tomentose stipe 1.5 to 2.5 cm long, linear, flat, pointed, greenish, tinged with purple till ripe, late in dehiscing. Seeds 12-15 suborbicular, flattened, 1.3 cm. wide and dark brown smooth (Kritikar and Basu, 1991).

Indian names: In India it is known by its various vernacular names, the most commonly used ones are Orchid tree (English), Khairwal, Kaniar (Hindi), Sarul (Kannada), Chuvanna Mandaram (Malayalam), Vanaraja (Sanskrit), Mandari (Tamil), Bodanta (Telgu), Kaanchanaara, Kaanchana (Ayurveda): Sivappumananchori (Siddha).

Medicinal uses: 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). Species of Bauhinia are rich in polyphenolics and are known for its medicinal properties (Patil, 2003). 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 tumor. The decoction of the root is used for expelling gases, flatulence and gripping pain from the stomach and bowel, the bark of the plant is used as an astringent in the treatment of diarrhea. Its decoctions are recommended for ulcers as a useful wash solution. 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 works 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 goiter (Shaarangadhar Samhitaa, Bhavprakaasha). Over the counter Kaanchanaara (B. purpurea) Guggulu (Shaarangadhar Samhitaa) is used to treat enlarge cervical glands, goiter and scrofulous tumors, so is kaanchan-gudikaa (Bhaishjya Ratnaavali). It has also been reported to contain high phenolics which are usually referred to as anti-quality factor for ruminant nutrition’s because of their high affinity with proteins (Yadav and Bhadoria, 2001). Although, there is no documentation on its traditional use to treat diseases among the Malaysians, this plant has been used in the Indian, Sri Lankan and Pakistani folklore medicine to treat ailments like glandular swellings, skin diseases, ulcers, diarrhea, stomach tumors and wounds (Jones and German, 1993). Several ethnomedicinal importance of B. purpurea is given in Table 1.
Table 1: Ethnomedicinal uses of different parts of *B. purpurea* Linn.

<table>
<thead>
<tr>
<th>Plant part used</th>
<th>Ethnomedicinal uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole plant</td>
<td>The whole plant is used in dropsy, pain, rheumatism, convulsions, delirium and septicemia (Asolkar et al., 2000)</td>
</tr>
<tr>
<td>Flowers</td>
<td>Flower buds and flowers fried in ghee are reported to be given to patients suffering from dysentery (Kalakoti and Pangtey, 1988). Flower buds also used as laxative and anthelmintic (Shiddamallayya et al., 2010)</td>
</tr>
<tr>
<td>Root</td>
<td>Root bark is mixed with curd and used in hemorrhoids. Its paste with dried ginger applied internally in the treatment of gaster. The root is carminative (Chatterjee and Pakrashi, 1992). Infusion of small piece of root is used for the treatment of white spot on race (Ramble et al., 2010)</td>
</tr>
<tr>
<td>Bark</td>
<td>The concentrated decoction of bark is used to treat lymph adenitis by tribal people of Jalgaon District (Pawar and Fatil, 2007). The decoction of stem bark orally twice a day is very effective in asthma and other respiratory disorder as an anti-inflammatory agent (Fatil et al., 2008). Also bark juice is useful in menstruation trouble and with honey is taken orally against leucorrhoea (Das et al., 2008)</td>
</tr>
</tbody>
</table>

**PHYTOCHEMISTRY OF *B. PURPUREA***

*B. purpurea* contain major class of secondary metabolites are glycosides, flavonoids, saponins, triterpenoids, phenolic compounds, oxepins, fatty acids and phytosterols. From the ethanolic extract of the whole plant of *B. purpurea* two new oxepins named bauhinianstatins1 and 2 have been isolated and the ethanolic extract of root provides bauhinianstatins 1, 2, 3 and pacharin (Fig. 1) exhibit significant growth inhibition against a minipanel of human cancer cell lines (Pottit et al., 2006). The structures have been established on the basis of chemical evidence and spectroscopic methods. A novel flavone glycoside, 5,6-dihydroxy-7-methoxyflavone 6-O-b-D-xylopyranoside (Fig. 2) was isolated from the chloroform-soluble fraction of the ethanolic extract of *B. purpurea* stems (Yadav and Tripathi, 2000). Three glycerol derivatives and 6- butyl-3-hydroxyflavanone derivatives are 2, 3-dihydroxypropyl oleate, 2, 3 dihydroxypropyl linoleate, 2, 3 dihydroxypropyl 15-hydrox-decanoate and 6-buty1-3-hydroxyflavanone, 6-(3'-oxobutyl)-taxifolin (Fig. 3) respectively isolated from methanolic extract of heartwood of *B. purpurea* (Kuo et al., 1998). The two new dimeric flavonoids namely bis [3',4'-dihydroxy-5-methoxy-7,8-furano-5',6'-mono methylalloxy]-5-C-5-biflavonyl and (4'-hydroxy-7-methyl 3-C-a-L-rhamnopyranosyl)-5-C-5(4'-hydroxy-7- methyl-3-C-a-D-glucopyranosyl) bioflavonoid (Fig. 4) with protein precipitating property obtained from 70% aq. acetone extract of *B. purpurea* leaves (Yadav and Bhadoria, 2005). The leaves of *B. purpurea* also afforded a mixture of phytol fatty esters, leutin and β-sitosterol (Fig. 5) (Ragasa et al., 2004). The petroleum ether fraction of ethanolic extract (95%) of *Bauhinia purpurea* leaf gave α- amyrin caprylate on successive column chromatography with petroleum ether (60-80°) and chloroform which gives Liebermann-Burchard test of triterpene. The compound is characterized by spectral analysis (Verma and Chandrashhekar, 2009). In the flower volatile oils of both *B. purpurea* and *B. variegata* found monoterpenes (e.g., a-terpinene, limonene, myrcene, linalool, citronellyl acetate) and a phenylpropanoid (eugenol) (Wassel et al., 1986). The aqueous methanolic extract of fresh flower of *B. purpurea* gives flavonoid quercetin and flavonoid glycosides isouceritin, astragalin (Fig. 6) (Ramchandra and Joshi, 1967) butein 4' O-β-L-arabinopyranosyl-O-β-D-galactoside (mp 265°) isolated from seed of *B. purpurea*. This gave the characteristic colour reactions of a chalcone and ion hydrolysis with 8% ethanolic H₂SO₄ for 12 h gave butein and a disaccharide, the component sugars which were found as galactose and
arabinose (Bharatiya et al., 1979). A new glycoside 3,4-dihydroxychalcone 4-O-β-L-arabinopyranosyl-O-β-D-galactopyranoside (mp 365°) isolated from seed which gave the characteristic colour reactions of a chalcone and gave 3,4-dihydroxychalcone, galactose and arabinose on acid hydrolysis (8% ethanolic H₂SO₄ for 12 h). The identity of sugars was confirmed by co-chromatography with authentic samples and by the preparation of their osazones (Bharatiya and Gupta, 1981). After chalcone glycoside a novel flavone glycoside were isolated, Glycoside-6-4'Diahydroxy-3'-prenyl-3,7,5,7'-Tetramethoxy Flavone-6-O-α-L-rhamnopyranoside
Fig. 4: Structure of dimeric flavonoids

Fig. 5: Structure of leutin and beta-sitosterol
Fig. 6: Structure of flavonoids and flavonoid glycosides

(Fig. 7) from acetone soluble of ethanolic extract from seed of B. purpurea which gives positive test for Molisch and structure are confirmed by spectral data analysis (Yadav and Sodhi, 2001). The CH₂Cl₂ extract of root of B. purpurea on purification yield 11 new compounds bauhinoxepin C-J, bauhinobenzofurin A, bauhispirorin A, bauhinol E, two flavanones (−)-strobopin and demethoxymatteucinol and five known bibenzyls (Fig. 8) which posses various pharmacological activities (Boophong et al., 2007). All the compounds were characterized by spectral analysis. Kachnar (B. purpurea) seeds were found to contain about 17.5% crude seed oil. The amount of neutral lipids in the crude seed oil was the highest (99% of total lipids), followed by glycolipids and phospholipids, respectively. Linoleic, followed by palmitic, oleic and stearic, were the major fatty acids in the crude seed oil and its lipid classes. The ratio of unsaturated fatty acids to saturated fatty acid, was higher in neutral lipid classes than in the polar lipid fractions. The oil was characterized by a relatively high amount of phytosterols, wherein the sterol markers were β-sitosterol and stigmasterol. β-Tocopherol was the major tocopherol isomer with the rest being δ-tocopherol (Ramadana et al., 2006). Bauhinia purpurea seed is a source of galactose and lactose binding lectin, a peptide which interact with carbohydrate. The amino acid sequence of peptide that bind with lactose is Asp-Thr-Trp-Pro-Asp-Thr-Glu-Trp-Ser and is obtained of Bauhinia purpurea lectin by affinity chromatography of peptide with Asp-N endoproteinase or trysin on column
of lactose-Sepharose 4B or lactose-, maltose-, fucose- and di-N-acetyllactosamine-Sepharose and by solid phase synthesis. This peptide exhibits lactose binding activity in the presence of calcium (Yamamoto et al., 1991).

PHARMACOLOGICAL PROPERTIES OF *B. PURPUREA*

**Antinociceptive, anti-inflammatory, analgesic and antipyretic properties:** The aqueous extract of leaf of *B. purpurea* possesses good antinociceptive, anti-inflammatory, analgesic and antipyretic. The crude dried extract was prepared in doses of 6.0, 30.0 and 60.0 mg kg⁻¹ and subjected to the respective. They have used antinociceptive (abdominal constriction, hot plate and formalin tests), anti-inflammatory (carrageenan-induced paw edema test) and antipyretic (brewer's yeast-induced pyrexia test) assays. The 6.0 mg kg⁻¹ AEBP exhibited the highest antinociceptive activity, the 30.0 mg kg⁻¹ AEBP exhibited an equieffective anti-inflammatory activity when compared to the 100 mg kg⁻¹ ASA only between the interval times of 1-4 h. The dose-independent antipyretic activity was observed only at the concentration 6.0 and 30.0 with the former showing remarkable activity even when compared with 100 mg kg⁻¹ ASA (Zakaria et al., 2007). In Zakaria et al. (2009) established the antinociceptive and anti-inflammatory activities of chloroform extract of *B. purpurea* leaves using animal models. The different dose 20, 100, 200 mg kg⁻¹ were prepared in dimethyl sulfoxide were 100 mg kg⁻¹ extract showed a less remarkable anti-inflammatory activity compared to the other doses tested. Analgesic and anti-inflammatory activities of ethanolic extract of stem of *B. purpurea* was subjected. Different CNS depressant paradigms like analgesic activity (Eddy's hot plate method and acetic acid writhing method) and anti-inflammatory activity (carrageenan induced paw edema) were carried out following the intra peritoneal administration of extract at dose level 50 and 100 mg kg⁻¹. Dose of 100 mg kg⁻¹ was comparable with standard drugs (Shreedhara et al., 2009). The aqueous and methanolic extract of the stem bark of *Bauhinia purpurea* were tested for anti-inflammatory activity at dose level 300 mg kg⁻¹ by carrageenan induced rat paw edema. Both the extract were tested against standard drug didohenac were ethanolic extract showed maximum activity, However the extracts activity is
Fig. 8: Structure of oxepins, flavones and bibenzyls

less than standard drug (Chandrashekar et al., 2009a, b). The ethyl acetate extract of stem bark of Bauhinia purpurea were found good analgesic activity tested at dose level 400 mg kg⁻¹ by acetic acid induced writhing model and hot plate method (Chandrashekar et al., 2009a).

**Antimalarial, antimycobacterial, antifungal and cytotoxicity activities:** The isolated compounds from roots exhibited antimycobacterial activity with MIC value ranging from 24.4 to 740.7 µM. Among all compounds bauhinoxepin J is a potent antimycobacterial agent activity having MIC 24.4 µM. Among the isolated metabolites, compounds 6, 7, 8 and 13 exhibited antimalarial activity (IC₅₀ 5.8-11.2 µM), while compounds 1, 4, 9, 15 and 18 exhibited antifungal activity (IC₅₀ 49.6-130.1 µM). Compounds 1, 2, 4, 6, 7, 8 and 18 exhibited cytotoxicity towards KB and BC cell line with IC₅₀ values ranging from 10.5 to 72.3 µM. Compound 4 and 7 posses potent anti-inflammatory activity inhibiting the COX-2 enzyme with IC₅₀ value of 6.9 and 10.1 µM respectively (Fig. 8) (Boophong et al., 2007).
Anti-diabetics: The rat showing blood glucose level 250-350 mg dL⁻¹ were considered as diabetic rat, induced by alloxan. The hypoglycemic activity of ethanolic extract and purified fraction-1 of stem of *B. purpurea* were studied and found that the dose of 100 mg dL⁻¹ (i.p.) reduces serum glucose level of Wister rats due to inhibition of cyclooxygenase and promote β-cell regeneration (Muralikrishna et al., 2008).

Cardiac activity: The cardiotonic activity of purified fraction-1 of ethanolic extract of stem of *B. purpurea* were studied and found that the fraction-1 has exhibited positive inotropic and chronotropic effect on isolated frog's heart. Its action is blocked by β₂-adrenergic blocker propranolol. The characterization of the isolated compound based on structural studies is under progress (Muralikrishna et al., 2008).

Hormone regulation: The aqueous alcoholic bark extract of *B. purpurea* (2.5 mg kg⁻¹ b.wt.) and aqueous root extract *Withania somnifera* (1.4 g kg⁻¹ b.wt.) on daily administration for 20 days, stimulating thyroid function in female mice. Both the plant extracts showed 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(s). Serum triiodothyronine (T₃) and thyroxine (T₄) concentrations were increased significantly by *Bauhinia, Withania* could enhance only serum T₄ concentration (Panda and Kar, 1999). In Panda et al. (2003) studied the role of *Emblica officinalis* L. and *Bauhinia purpurea* L. extracts in regulating thyroid functions was studied in male mice. Oral administration of *Emblica officinalis* L. fruit extract at 30 mg kg⁻¹ body weight (b.wt.) each day for 20 days decreased serum T₃ and T₄ concentrations and hepatic O₂ consumption. In contrast daily administration of *B. purpurea* at 2.5 mg kg⁻¹ b.wt. each day for 20 days increased serum T₄ concentration and O₂ consumption. Both the plant extracts exhibited hepatoprotective effects as evidenced by decreased lipid per oxidation (Panda et al., 2003).

Antioxidant activity: The antioxidant activity of ethanolic extract (95% v/v) of leaves of *B. purpurea* exhibited significant free radical scavenging activity and reducing power activity when compare with ascorbic acid. The IC₅₀ values were found to be 78.31 and 59.37 μg mL⁻¹ for ethanolic extract of leaves of *B. purpurea* and ascorbic acid, respectively (Joshi et al., 2009). The ethanolic extracts of aerial parts do not shows antioxidant activity (Silva et al., 2005).

Nephroprotective: The ethanolic extract of leaves and unripe pods of *B. purpurea* shows protective action on kidney induced by gentamicin induced nephrotoxicity. Extracts were administered intraperitoneal at dose level 300 mg/kg/day for eight days reduces blood vessel congestion, epithelial desquamation, accumulation of anti-inflammatory cells and necrosis of kidney cells. This normalizes the increased level of serum creatinine, uric acid, urea and blood urea nitrogen (Lakshmi et al., 2009).

Wound healing activity: Four different models excision, incision, burn and dead space wound were used to determine wound healing properties of chloroform and methanol extracts of leaves of *B. purpurea*. Low dose 2.5% (w/w) and high dose 5% (w/w) of chloroform and methanol extracts were prepared in hydrophilic and hydrophobic bases for excision, incision, burn wound models applied topically. Aloe vera 5% (w/w) was used as a standard. For dead space wound model
100 and 500 mg kg$^{-1}$ and as a standard Aloe vera 300 mg kg$^{-1}$ were given orally. *B. purpurea* is having almost equal activity with Aloe vera in all four wound healing models (Ananth et al., 2010).

**Anti-diarrheal activity:** The ethanolic extract of leaves shows inhibitory effect at different dose level on animal models castor oil induced diarrhea in rats and gastrointestinal motility test by using charcoal meal. This inhibitory effects support the use of the leaves of *B. purpurea* in folklore medicine (Mukherjee et al., 1998).

**CONCLUSIONS**

The scientific research on *B. purpurea* is suggests a huge biological potential of this plant. It is strongly believed that detailed information as presented in this review on the phytochemical and various biological properties of the extracts might provide detailed evidence for the use of this plant in different medicines. The phytochemical variations and efficacy of the medicinal values of *B. purpurea* is dependent on geographical locations.

Even today, plants are the almost exclusive source of drugs for a majority of the world population. Therefore, it remains a challenge for scientist to provide efficient, safe and cheap medication especially for rural area. These *Bauhinia* species and their quantification of individual phytocomponents as well as pharmacological profile based on in vitro, in vivo studies and on clinical trial should be further investigated.

**REFERENCES**


