

Full Length Article

Bauhinia variegata Linn. : Traditional and Scientific Validation

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ABSTRACT

Bauhinia variegata is a species of flowering plant belong to family Fabaceae, native to South Asia and Southeast Asia, from southern China, Burma, India, Nepal, Pakistan, and Sri Lanka. Common names are orchid tree, camel's foot tree, kachnar and mountain-ebony. *Bauhinia variegata* is a widely used as medicinal plant distributed in the tropical regions. Various part i.e. flowers, buds, stem, roots, bark, seeds, leaves have been used since ancient times for the treatment of a wide range of diseases. It is used traditionally in dysentery, diarrhea, hemorrhoids, piles, edema, laxative, anti-helminthic, astringent, anti-leprotic, wound healing, anti-goitrogenic, anti-tumor, antidote for snake poisoning, dyspepsia, anidiabetic and carminative disease. The pharmacological studies showed that *Bauhinia variegata* exerted anticancer, antioxidant, hypolipidemic, antimicrobial, anti-inflammatory, nephroprotective, hepatoprotective, antiulcer, immunomodulating, molluscicidal and wound healing effects. This review focused and highlight the scientific and traditional values of *Bauhinia variegata*.

Keywords: *Bauhinia variegata*, phytochemistry, pharmacology

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INTRODUCTION

It is grown all over India in beautiful gardens and its self grown trees are found in forests, in the Himalayan valleys and in lower hilly region. Based on the flower types its three main varieties are identified as purple rose: *Bauhinia purpurea*, white to purplish: *Bauhinia variegata* and yellow flowered: *Bauhinia tomentosa*. Yellow flowered trees are large in size and grow in hilly areas and its flowers and leaves are larger than the other two varieties. For medicinal purposes generally the white to purplish: *Bauhinia variegata* is used which is described here but in properties all three are the same. This is why if one variety is not available the other variety can be used. *Bauhinia acuminata* white flower is also used as an ornamental garden plant. It was native to Southeast Asia and grows in tropical and subtropical climate [1-3]. All parts of the plant like leaves, flower buds, flower, stem, stem bark, seeds and roots were used in traditional medicine and diseases. It was traditionally used in the treatment of bronchitis, leprosy, and tumors. The stem bark was used as astringent, tonic, anthelmintic and antidiabetic. Infusion of the leaves was used as a laxative and for piles. Dried buds were used in the treatment of worm infestations, tumors, diarrhea, and piles [4].

The phytochemical screening revealed that *Bauhinia variegata* contained terpenoids, flavonoids, tannins, saponins, reducing sugars, steroids and cardiac glycosides. Pharmacological studies showed that *Bauhinia variegata* exerted anticancer, antioxidant, hypolipidemic, antimicrobial, anti-inflammatory, nephroprotective, hepatoprotective, antiulcer, immunomodulating, molluscicidal and wound healing effects [5].

CLASSICAL CATEGORIZATION

Charaka Samhita – Vamanopaga – group of herbs that is useful in Vamana Panchakarma therapy (emesis)

Sushruta Samhita – Kashayavarga – group of astringent tasting herbs

Urdhvabhagahara – group of herbs useful in Vamana therapy

AYURVEDIC PROPERTIES

Guna (qualities) – Laghu (light to digest), Rooksha (dryness)

Rasa (taste) – Kashaya (Astringent)

Vipaka – taste conversion after digestion – Katu (pungent)

Veerya – Sheeta – Cold potency

Prabhava – Special effect – Gandamala nashana – Useful in cervical lymphadenitis, thyroid complications.

Effect on Tridosha – Relieves Kapha and Pitta

Grahi – absorbent

Krumighna – relieves worm infestation

Kushtaghna – useful in skin diseases

Gudabhramsha – useful in the treatment of rectal prolapsed

Gandamala – useful in cervical lymphadenitis, Thyroid problems

Pittasra – useful in bleeding disorders

Pradara – useful in menorrhagia (heavy menstrual bleeding)

Kasanut – Useful in cough and cold

TAXONOMIC STATUS

Kingdom: Plantae

Division: Tracheophyta

Class: Magnoliopsida

Order: Fabales

Family: Fabaceae

Genus: *Bauhinia*

Species: *variegata*

BOTANIC DESCRIPTION [6,7]

Bauhinia variegata is a small to medium-sized deciduous tree with a short bole and spreading crown, attaining a height of up to 15 m and diameter of 50 cm. In dry forests, the size is much smaller. The bark is light brownish grey, smooth to slightly fissured and scaly. Inner bark is pinkish, fibrous and bitter. The twigs are slender, zigzag; when young, light green, slightly hairy, and angled, becoming brownish grey. Leaves have minute stipules 1-2 mm, early caducous; petiole puberulous to glabrous, 3-4 cm; lamina broadly ovate to circular, often broader than long, 6-16 cm diameter; 11-13 nerved; tips of lobes broadly rounded, base cordate; upper surface glabrous, lower glaucous but glabrous when fully grown. Flower clusters (racemes) are unbranched at ends of twigs. The few flowers have short, stout stalks and a stalklike, green, narrow basal tube (hypanthium). The light green, fairly hairy calyx forms a pointed 5-angled bud and splits open on 1 side, remaining attached; petals 5, slightly unequal, wavy margined and narrowed to the base; 5 curved stamens; very slender, stalked, curved pistil, with narrow, green, 1-celled ovary, style and dotlike stigma. Pods dehiscent, strap-shaped, obliquely striate, 20-30 by 2-25 cm; long, hard, flat with 10-15 seeds in each; seeds brown, flat, nearly circular with coriaceous testa. The generic name commemorates the Bauhin brothers Jean (1541-1613) and Gaspard (1560-1624), Swiss botanists. The two lobes of the leaf exemplify the two brothers. The specific name refers to the variegation of the flowers [7].

BIOLOGY In its natural habitat in India, the tree is deciduous, remaining leafless from Jan-Feb to April with leaf fall in Nov-Dec. Flowering occurs when the plant is leafless. Tree starts flowering at a very early age of 2-3 years. The seeds disperse from the pods and germinate on sites with favourable light and moisture conditions, while in unfavourable niches the radicle dries up or is destroyed by birds.

ECOLOGY

B. variegata is a plant of tropical and subtropical climates with hot, dry summers and mild winters. It demands plenty of light and requires good drainage. Severe frost kills the leaves of seedlings and saplings, but they recover during summer. The tree is fairly resistant to drought but susceptible to fires.

BIOPHYSICAL LIMITS

Altitude: up to 1 800 m, Mean annual temperature: 0-47 deg. C, Mean annual rainfall: 500-2 500 mm Soil type: Capable of growing on a wide range of soils from gravelly, shallow, rocky soil on hill slopes to sandy loam and loamy soil in the valley.

PHYTOCHEMICAL PROPERTIES

Yields flavonoids: quercetin, rutin, apigenin and apigenin 7-O-glucoside. Phytoscreening reported flavonoids, lectin and albumin. Stem yields sitosterol, lupeol, kaempferol-3-glucoside and 5,7-dihydroxy

and 5,7-dimethoxy flavanone-4-O-L-rhamnopyranosyl-Dglucopyranosides. Flowers contain cyanidine-3-glucoside, malvidin-3-glucoside, malvidin-3-diglucoside, and peonidin,3-diglucoside, kaempferol-3-galactoside and kaempferol-3- rhamnoglucoside. Root bark yielded a new flavanone: (2S)-5,7-dimethoxy-3'- 4' -methylene dioxyf lavanone and a new dihydrobenzoxepin 5,6-dihydro-1,7dihydroxy-3,4- 2,3 dimethoxy-2-methylidibenz (b,f) oxepin [8-11].



Fig 1: flower and Plant of *Bauhinia variegata*

PHARMACOLOGICAL PROPERTIES

Anti-diabetic action: Oral administration of Different extract of leaves and stem bark of *Bauhinia variegata* at different doses i.e 200 and 400 mg/kg in streptozotocin (STZ) and alloxan-induced diabetic rats reduced the elevated blood glucose level by increasing glucose metabolism [31, 16]. Further it has been discovered that insulin-like proteins found in leaves of *Bauhinia variegata* are responsible for glucose metabolism [9]. Treatment of ethanolic extract of *Bauhinia variegata* leaves at a dose of 300 mg/kg decreased the blood sugar level and increased lipid profile except LDL [9]. It has been noted in an *in vitro* study that ethanolic extract of leaves of *Bauhinia variegata* and roseoside (active constituent) increased the release of insulin in beta-cell line INS-1 and suggested that treatment of ethanolic extract of bark at 250 mg/kg and 500 mg/kg improved blood glucose level by regenerating β -cells in alloxan-induced rats [10, 11].

Anti-ulcer activity: Administration of alcoholic extract of stem of *Bauhinia variegata* at a dose of 250 mg/kg in pylorus ligation-induced and aspirin-induced gastric ulcer in rats reduced the ulcer index by decreasing gastric secretions [13]. Another study showed that flavonoids present in aqueous and ethanolic extract of *Bauhinia variegata* roots in ethanol induced, aspirin-induced and pylorus ligation-induced ulcer in rats has the potential to prevent ulcer formation via mechanisms such as stimulation of PG synthesis, scavenging free radicals and inhibition of acid and pepsin secretion [14]. Another study, fixed-oils present in petroleum-ether and aqueous extract of bark of *Bauhinia variegata* showed anti-ulcer activity in aspirin plus pylorus ligation-induced gastric ulcer in rats via inhibiting H₂-receptor [15].

Anti-inflammatory activity: Anti-inflammatory activity of ethanolic extract of *Bauhinia variegata* stems at a dose of 250 mg/kg in complete Freund's adjuvant (CFA)- induced arthritis in rats showed preventive action by decreasing the generation of free radicals and lipid peroxidation via improving the anti-oxidant enzyme status [16]. Further, ethanolic extract of *Bauhinia variegata* leaves and petroleum ether fraction of this extract in carrageenan-induced rat paw edema and cotton pellet-induced granuloma in rats reduced the inflammation by inhibiting proliferation of inflammatory cells like macrophages, fibroblasts and neutrophils [17]. A preliminary phytochemical study showed that flavonol glycosides present in roots of *Bauhinia variegata* were worked as a antiinflammatory activity [18].

Anti-oxidant activity: *In vitro* studies revealed that ethanolic extract of *Bauhinia variegata* leaves, stem, bark and roots reduced the oxidative stress by reducing the generation of free radicals [19]. Further, methanolic extract of *Bauhinia variegata* stem, bark and floral buds prevented oxidative stress in deoxyribose method and showed genoprotective and antioxidant action against H₂O₂-induced oxidative damage to pBR322 DNA by attenuating the levels of hydroxyl radicals by free radical scavenging mechanism [20, 21]. A recent study showed that *in vitro* research showed that polyphenols and flavonoids present in *Bauhinia variegata* have been responsible for its antioxidant potential [22]. An *in vitro* study revealed that ethanolic extract of *Bauhinia variegata* leaves reduced the oxidative stress via elevating the levels of anti-oxidant enzymes and reducing the levels of lipid peroxides and hydroperoxides [23].

Hepatoprotective activity: It was found that alcoholic extract of stem bark of *Bauhinia variegata* (100 and 200 mg/kg) on oral administration in carbon tetrachloride (CCl₄)-induced toxicity in rats reduced the levels of total lipids and proteins by normalizing the levels of aspartate aminotransferase (AST), alkaline phosphatase (ALP), alanine aminotransferase (ALT) and gamma glutamyl transpeptidase (GGT) [23]. Another study revealed that ethanolic extract of *Bauhinia variegata* leaves in paracetamol-induced hepatotoxicity in rats at dose of 200 and 400 mg/kg for 7 days showed improvement in hepatocytes by enhancing of parenchymal cells [24]. Administration of ethanolic extract of *Bauhinia variegata* at dose of 250 and 500 mg/kg for 10 days in paracetamol-induced hepatotoxicity in rats showed preventive action by improving the lipid profile and oxidative status via its antioxidant potential [25].

Anti-cancer activity: An *in vitro* study revealed that *Bauhinia variegata* extract showed anti-cancer activity by inhibiting the growth of these cell lines [26]. Another study found that methanolic extract of *Bauhinia variegata* leaves at dose of 300, 600 and 900 mg/kg in cyclophosphamide-induced mutagenesis in bone marrow cells of mice showed antimutagenic action by preventing the formation of micronucleus and chromosomal aberrations [56]. Ethanolic extract of *Bauhinia variegata* showed preventive action against Dalton's ascetic lymphoma in mice by increasing peritoneal cell counts [27]. Various studies have demonstrated the anti-cancer activity of *Bauhinia variegata* exhibited via increasing the levels of anti-oxidant enzymes and subsequently decreasing free radical generation and lipid peroxidation, which may be attributed to the flavonoids present in it [28].

Anti-microbial activity: The ethanolic extract of *Bauhinia variegata* leaves have potential to inhibit some gram negative (*Escherichia coli*, *S. flexinera*, *P. auriginosa* and *Salmonella typhi*) and gram positive bacteria (*Staphylococcus aureus*, *B. subtilis*, *S. aureus* and *S. epidermis*) in agar plate method [29]. Another study revealed that saponins, flavonoids, cardiac glycosides and tannins present in leaf extract of *Bauhinia variegata* showed anti-fungal activity against *Candida albican*, *Aspergillus fumigatus*, *Cryptococcus neoformans* [30]. Further, quercetin and saponins present in ethanolic extract of *Bauhinia variegata* leaves have been found responsible for molluscicidal action against snail *Lymnaea acuminata* [31].

Immunomodulatory activity: It was found that ethanolic extract of *Bauhinia variegata* stem bark for 21 days in sheep RBCs-immunized mice showed immunomodulatory activity by inhibiting cyclophosphamide induced and cyclosporin-induced suppression of humoral immunity via activating the specific cell mediated immune response, exhibited by the activation of monocyte macrophage system and natural killer (NK) cells [33]. Further tannins present in acetone: water extract of *Bauhinia variegata* stem bark at various concentrations (10, 20, 50, 100 and 1000 µg/ml) showed immunomodulatory action by enhancing the phagocytosis of the microorganisms via increasing the chemotactic movement of human neutrophils [34].

Anti-hyperlipidemic activity: Treatment with ethanolic and aqueous extract of *Bauhinia variegata* leaves, roots and bark in STZ-induced diabetic rats and in Triton WR-1339 (Tyloxapol and iso-octyl polyoxyethylene phenol)-induced hyperlipidemic rats showed antihyperlipidemic activity by lowering the levels of TC, low density lipids (LDL), very low density lipids (VLDL) and by elevating the levels of high density lipids (HDL) [10, 35].

Other activities

Aqueous and ethanolic extract of *Bauhinia variegata* roots on oral administration at dose of 200 and 400 mg/kg in acetic acid-induced writhing and Eddy's hot plate model of algia in mice showed analgesic activity by inhibiting the production and action of prostaglandins like PGE₂ and PGF₂ α and by preventing transmission of painful impulses [36].

Ethanolic extract at dose of 200 mg/kg in yeast induced-hyperthermic rats showed antipyretic activity by inhibiting the synthesis of PGs in hypothalamus of rat brain [67]. Ethanolic extract of *Bauhinia variegata* whole stem at dose of 200 and 400 mg/kg b.w in cisplatin-induced nephropathy in rats showed nephroprotective action by ameliorating the levels of serum urea and creatinine [37]. Ethanolic extract of *Bauhinia variegata* leaves at dose of 400, 600 and 800 mg/kg in maximum electric shock-induced and pentylenetetrazol (PTZ)-induced convulsions in mice showed protective action by inhibiting the initiation of seizures via blocking NMDA receptors [66]. Lectin, a phytochemical found in seeds of *Bauhinia variegata* and its recombinant isoform (rBVL-1) in surgically induced dorsal skin wounds in mice showed wound healing potential by augmenting proinflammatory response, collagen synthesis by fibroblasts and by enhancing angiogenesis via altering the release of inflammatory cytokines and growth factors [38]. Fresh juice of flowers and dried buds of *Bauhinia variegata* are used for the treatment of diarrhea and other stomach disorders.

CONCLUSION

The present review revealed that *Bauhinia variegata* possess various bioactive constituents and act as anti-diabetic, anti-oxidant, anti-ulcer, immunomodulatory, nephroprotective, anti-microbial, anti-bacterial, anti-cancer and hepatoprotective agent.

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