

PHYTOCHEMICAL AND PHARMACOLOGICAL PROPERTIES OF BAUHINIA ACUMINATA

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ABSTRACT

Bauhinia species including (*Bauhinia acuminata*, *Bauhinia variegata*, *Bauhinia purpurea*, *Bauhinia monandra*, *Bauhinia galpini*) are popular ornamental plants usually woody ornamentals or herbaceous lianas with attractive flowers typical of the leguminosae of arid temp. sub – tropical and tropical zones . *Bauhinia* species are also have many multiple medicinal and biological properties . Phytochemical screening of two species viz . *Bauhinia acuminata* and *Cassia occidentalis* belonging to family caesalpiniaceae was performed using generally accepted laboratory technique . Three solvent viz. chloroform, Benzen, and petroleum ether were used for extraction. The constituents were alkaloids,

flavonoids, glycosides, saponin, steroids, and tannin. The distribution of these constituents in the leaves of selected species were assessed and compared . Preliminary phytochemical screening of *Bauhinia acuminata* did not reveal alkaloids. Glycoside, steroid, and flavonoids were present in both of species . Tannin was present in *Cassia occidentalis* while absent in *Bauhinia acuminata* . Saponin was absent in *Cassia occidentalis* while present in *Bauhinia acuminata* . The extraction of leave of *Bauhinia acuminata* and its kupchan fraction were screened for antioxidant , cytotoxic, membrane stabilizing, hemolytic and antimicrobial activity .

KEYWORDS: *Bauhinia acuminata*, Pharmacognosy, Phytochemicals, and Pharmacology.

INTRODUCTION

Medicinal plants are nature's priceless gift to human . Plant material have been used for the treatment of serious diseases throughout the world before the advent of modern clinical drug. The use of medicinal plants still plays an important role to cover the

basic health need in the developing countries. Medicinal plants used for centuries as remedies for human diseases because they contain natural compound which play a dominant role in the development of novel drug lead for treatment and prevention of diseases.^[1-2] The medicinal value of plants lies in some chemical substance or group of compound that produce a definite physiological action in the human body.

These chemical substance are called secondary metabolite. The most important of these bioactive group of plants are alkaloids, terpenoids, steroids, flavonoids, tannins and phenolic compounds.^[3] These bioactive substances are found to be distributed in plants yet these compounds were not established due to lack of knowledge and technique.^[4] In recent years secondary metabolites with unknown pharmacological activities have been extensively investigated as a source of medicinal agent.^[5] Flavonoids and phenols are strong antioxidants and have an important role in the health care system.^[6] Screening of active compound from plants has lead to the discovery of new medicinal drug which have efficient protection and treatment roles against various diseases including cancer and alzheimer's diseases.^[7] Screening of various natural organic compounds and identifying active agents is the need of the hour, because successfully prediction of drug like properties at the onset of drug discovery will pay off later in drug development. The family Casalpiniaceas is extremely rich in flavonoids . Kampferol and Quercetin have been reported from flavonol group while Apigenin and Luteolin from flavones group in the members of this family.^[8] Flavonoides are known antioxidant, of which Quercetin is a potent antioxidant.

The seeds storage protein analysis helps in identification and characterization of diversity in crop varieties and also provides information on phylogenetic relationship of the accession.^[9-11] The aim of the present study were to evaluate the chemical constituents of *Bauhinia acuminata* and *Cassia occidentalis* species of family Caesalpiniaceae .These species have been of keen interest in phytochemical and pharmacological research due to their excellent medicinal values. They are well known in folk medicine for their laxative and purgative uses.^[12] *Bauhinia acuminata* leaves have antidiabetic action^[13] and *Cassia occidentalis* is a medicinal herb found to have many disease preventive properties.^[14] Hence the present study was carried out to evaluate the phytochemical constituents of *Bauhinia acuminata* leaf.

PLANT PROFILE

The genus *Bauhinia*, one of the largest genera in sub-family caesalpiniaceae represent more than 300 species.^[15] *Bauhinia* has been extensively planted as a garden, park and roadside ornamental tree in many warm temperate and sub-tropical region.^[16] *Bauhinia* is also known as Mountain ebony. The term *Bauhinia* is derived from the new Latin word 'Bauhin'. The synonym of *Bauhinia* is 'dwarf white orchid tree'. The genus was named after the Bauhin brothers. Swiss-French botanists: Jean Bauhin (1541 – 1612) and Gaspard Bauhin (1560 – 1624).^[17] Many species are widely planted in the tropics as ornamental, particularly in northern India, Vietnam and southeastern China.



Many species cultivars, and varieties are available. *Bauhinia acuminata* L. is seedless and would not present such a litter problem. It is the most spectacular and most wanted *Bauhinia* spp; bearing six – inch, orchid – like flowers of rich redish rose purple during the winter but is very tender to freezing temperatures. *Bauhinia variegata*, most popular, produces in winter and spring most nearly orchid – like blossoms of purplish casts or pure white in cultivar 'Candida'. *Bauhinia purpurea*, most variable, produces narrow - petaled, red – purple to blue – purple flowers in late fall and early winter while leaves are on the trees. *Bauhinia monandra* produces pink, single - stamened flowers all summer. *Bauhinia acuminata* also blooms all summer but with white flowers.^[18]

BAUHINIA ACUMINATA : Dwarf white orchid tree

Native : Asia
Family : Caesalpiniaceae
Height : 2-3 m
Leaf shape : Bilobed

VERNACULAR NAME

English	: Mountain ebony
Hindi	: Safed kachnar
Tamil	: Vellai mandaarai
Manipuri	: Chingthrao angouba
Malayalam	: Mandaoram
Kannade	: Kanchan
Assamese	: Mati – katota
Sanskrit	: Sivamali

GEOGRAPHICAL DISTRIBUTION

Bauhinia acuminata is widely cultivated for its ornamental value require very less space to grow. This species occurs widely in deciduous forests and scrub.

MACROSCOPY

It is a cultivated shrub of 3 m tall ; young stems, petioles and inflorescence axes sparse curled pubescence . Stipules lance – linear, 5 – 12 mm long acuminate, curled puberulent, caducous; largest collector swollen, divergent, 1.5 – 2.1 mm long. Leaves with petioles 1.5 -4 cm long; blades ovate, broadly ovate or suborbicular, 5.4 – 11.3(20)x3.7-11.3 cm, divided about 1/3 their length, membranous, glabrous adaxially, densely puberulent abaxially, base cordate to rounded, apex of lobes acute. Inflorescence axillary racemes, 2.5 -5.8 cm long; peduncles negligible; bracts and bracteoles lance – linear, 3 – 9 mm long, puberulent, especially on margins, caducous. Flowers with pedicel 6 – 12 mm long; hypanthium 5 – 9 mm long; calyx limb spathaceous, 28 – 37 mm long, with few scattered hairs abaxially, apex of 5 spiere lobes 1.7 – 4.1 mm long ; petals not clawed, elliptic to oblanceolate, 39 – 40 (60) x 20 – 25 (30) mm, glabrous, white; fertile stamens 10, filaments strigose at base; ovary stipitate, strigose on sutures, stigma peltate, bilobed . Legmumes linear, 7.5 – 15 x 1.7 – 1.8 cm, glabrous, brown; seeds suborbicular, ca. 10 mm diameter.^[19,20,21] *Bauhinia* is grown in the best sunlight or high, shifting pine shade and it thrives in any well – drained soil but in alkaline soils and micronutrient deficiency can show interveinal chlorosis (yellowing) on the leaves . The wood tends to be weak and sprouts are often seen growing from the base of the tree creating an unkempt appearance . Besides this the fallen leaves messy because they are large and decompose slowly . Chewing

insects and borers may present and this can create a problem for *Bauhinia*. Because of over-watering because it may tend to turn the foliage yellow.^[22,23]

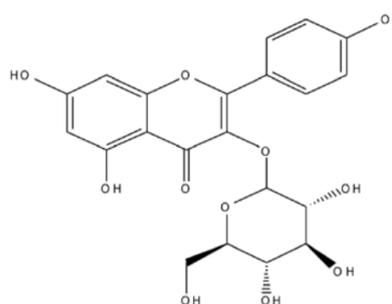
LEAF : Leaves are bilobed, shaped like an ox or cow hoof; long and broad with the apical cleft.

FLOWER : Flowers are fragrant with five white petals, ten yellow tipped stamens and a green stigma.

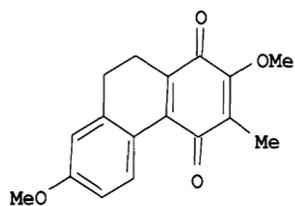
FRUIT : Fruit is a pod 7.5 to 15 cm long and 1.5 to 1.8 cm broad.^[24]

CHEMICAL CONSTITUENT AND PHYTOCHEMICAL ACTIVITY OF *BAUHINIA ACUMINATA*

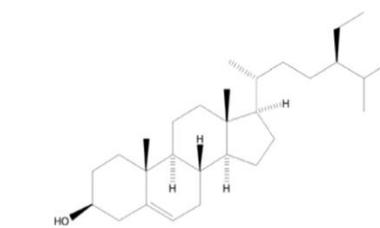
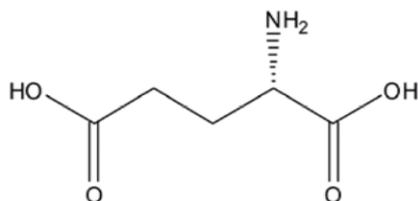
Bauhinia acuminata is a species of flowering shrub native to tropical southeastern Asia. The leaves, bark, root, flowers, and seed, of this plant are used in traditional medicine. It is employed in the treatment of glandular swelling, skin diseases and ulcer. The chemical constituents found in *Bauhinia acuminata* were vitamin C (leaves), beta-sitosterol, lupeol, kaempferol, 3, 5, 7-dehydroxy- and 5, 7-dimethoxy-flavanone-4-O-alpha-L-rhamnopyranosyl-beta-D-glucopyranosides. In *Bauhinia acuminata* flavonoids showed presence of kaempferol, Quercetin, and Apigenin. Kaempferol, Quercetin, and Apigenin were present in both the species. Derivatives of Quercetin i.e. Quercetin-3-glycoside was present in *Bauhinia acuminata* while Quercetin-7-glycoside was in *Cassia occidentalis*.^[25] Several chemical compounds including palmitic acid, three phthalic acid esters, phthalic acid, gallic acid, ursolic acid, were identified from the leaves of *Bauhinia acuminata*.^[26] Phytochemical screening showed the presence of carbohydrate, phenolic compounds, saponins, flavonoids, oils and fats in leaves and stems of *Bauhinia acuminata*. Antioxidant potential activity is mainly due to their phenolic compounds.^[27]



Kaempferol-3-glucoside



Bauhinione

 β -sitosterol

Glutamic acid

The plant contain crude protein 23%, crude fiber 20.8%, lipid 24.9%, and carbohydrate 48%.^[28] The phytochemical analysis showed that the different part of plant contain different chemical group included alkaloids, anthocyanoside, phenolics, proteins, phlobatannins, steroids, tannins, flavonoids, anthraquinone, saponins, terpenoids, resins, balsams, amino acid, carbohydrate, sugars and cardiac glycosides.^[29,30]

TRADITIONAL USES

Bauhinia acuminata is a species of flowering shrub native to tropical southeastern Asia. The bark, flower, and root of the *Bauhinia acuminata* are used for various skin diseases, worms, tumours, and diabetes.^[31] The bark and leaves of *Bauhinia acuminata* is used to treat biliousness^[32] is a remedy recommended by the Indian *vaidyas*.^[33] In Malaysia and Indonesia the plant is used in the treatment of common cold and cough.^[32] While in India the leaves and bark of this plant are used for treating asthma.^[33] Moreover, the leaf of *Bauhinia acuminata* is used to treat bladder stone, venereal diseases, leprosy, asthma and digestive diseases.^[34] Though different part of this plant were reported to good medicinal properties.^[35] Defferent part of this plant such as bark, leaves, stem, flowers and roots have been used in traditional medicine.^[36] Leaves were used externally and internally in skin disease scabies and

ringworm. Hot decoction preferred to quinine for its tonic properties. Paste of leaves and calcium hydroxide applied to abscesses for quick opening and clearing of pus.^[37,38] The paste of leaves was externally applied to wounds, sores, itch, cutaneous disease, bone fracture, fever, ringworm, skin disease, throat infection, and to cure sore eyes. The leaves/root were ingredient of many popular herbal liver tonic and medicines for liver disorders. People use it also for the treatment of insect bites, snake bite, scorpion sting, constipation, oedema, fever, inflammation, rheumatism.^[39] Its roots, leaves, flowers and seeds were used as laxative and purgative.^[40] The plant was also used as febrifuge, vermifuge, anticonvulsant and against chicken pox, guinea worm and black quarter.^[41,42]

PHARMACOLOGICAL ACTIVITIES

ANTIBACTERIAL ACTIVITY

The antibacterial activity of the hexane, methanol, chloroform and water extract of *Bauhinia acuminata* and *Cassia occidentalis* was tested against *E. coli*, *P. multocida*, *S. typhi*, *S. typhimurium*, *S. pyogenes*, *S. pneumoniae*, and *K. pneumoniae*. The result showed that *E. coli* was the most susceptible microorganism.^[43] Antibacterial activity of *Bauhinia acuminata* flower extract was evaluated against *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Pseudomonas aeruginosa*. The result showed that all the extracts had activity against *Klebsiella pneumoniae* at a concentration between 30 – 90 mg/ml. The minimum inhibitory concentration ranged between 35 – 55 mg/ml for water extract and 25 – 55 mg/ml for chloroform extract. The minimum bactericidal concentration was 55 mg/ml by both water and chloroform extract.^[44] Antibacterial activity of various extract of *Bauhinia acuminata* seeds was evaluated against three respiratory tract pathogens (*Staphylococcus aureus* MTCC 1144, *Streptococcus pneumoniae* MTCC 655, *Streptococcus pyogenes* MTCC 442). The result showed that methanol extract was active antibacterial other than extract. The zone of inhibition exhibited by methanol extract against tested microorganism.^[45,46,47]

ANTIFUNGAL ACTIVITY

Crude extract of different part (leaf, seed, and pod) of *Bauhinia acuminata* was examined for their antifungal activity against three fungi viz. *Candida albicans*, *Aspergillus clavatus* and *Aspergillus niger*. Antifungal activity of different plant parts in terms of minimal inhibitory concentration ranged between 200 -1000 µg/ml. The

extracts performed as good as oven better than the standard drugs nystatin and gresefulvin with exception of activity of leaf extract against *Aspergilli*.^[48]

ANTI-ANXIETY AND ANTI-DEPRESSANT EFFECT

(a) ANTI-ANXIETY EFFECT

The anti-anxiety activity of the ethanolic and aqueous extract of *Bauhinia acuminata* leaves was evaluated in rodents. Anti-anxiety activity was tested by exposing rats to unfamiliar aversion in different methods like elevated plus –maze model and actophotometer. In elevated plus – maze test, the ethanolic extract of *Bauhinia acuminata* leaves at a dose of 500 mg/kg orally, significantly increased the number of entries and time spent into the open arm. The magnitude of the anti-anxiety effects 500 mg/kg orally, of ethanolic and aqueous extract of *Bauhinia acuminata* was comparable to that of diazepam 5 mg/kg ip. The average of basal activity scores after 30 and 60 min of administration of ethanolic and aqueous extracts of *Bauhinia acuminata* leaves 500 mg/kg orally, showed significant reduction of the locomotor activity.^[49]

(b) ANTI-DEPRESSANT EFFECT

The antidepressant activity was tested by using despair swim test and tail suspension test. In despair swim apparatus, the ethanolic and aqueous extracts of leaves of *Bauhinia acuminata* at a dose of 500 mg/kg orally, significantly decreased the immobility time. The magnitude of the antidepressant effect of 500 mg/kg orally, of methanolic and aqueous extracts of leaves of *Bauhinia acuminata* was comparable to that of fluoxetine 10 mg/kg ip. In tail suspension test, the ethanolic and aqueous extracts of leaves of *Bauhinia acuminata* at a dose 500 mg/kg orally, significantly decreased the immobility time. The magnitude of antidepressant effect of 500 mg/kg orally, of ethanolic and aqueous extract of leaves of *Bauhinia acuminata* was comparable to that of fluoxetine 10 mg/kg ip. Ethanolic extract of *Bauhinia acuminata* leaves showing more significantly antidepressant activity over the aqueous extract.^[49]

ANTI-DIABETIC EFFECT

The methanolic extract of *Bauhinia acuminata* leaves was tested against alloxan – induced diabetic mice. The diabetic in the experimental mice was induced by a single intraperitoneal injection of alloxan. Treatment with *Bauhinia acuminata* leaf extract at different dose (200 mg/kg, 300 mg/kg, and 450 mg/kg orally), significantly reduced

blood glucose level to normal in a diabetic mice.^[50] The aqueous extract of *Bauhinia acuminata* produced a significant reduction in fasting blood glucose level in the normal and alloxan – induced diabetic rats. Petrollium ether extract showed activity from day 14 and chloroform extract showed activity from day 7. Significant differences were observed in serum, lipid profiles(cholesterol and triglyceride), serum protein, and changed in boy weight by aqueous extract treated – diabetic animals. When compared with the diabetic control and normal animals. Concurrent histapathological studies of the pancreas of these animals showed comparable regeneration by extract which were earlier necrosed by alloxan.^[51]

MEMBERANE STABILIZING ACTIVITY

The membrane stabilizing activity of the extractives was assessed by using hypotonic solution – induced and heat – induced hemolysis of mice erythrocyte.^[52] In hypotonic solution – induced method , the test sample consisted of stock erythrocyte (RBC) sodium salicylic acid (0.1 g/ml). 0.5 ml of RBCs mixed with hypotonic – buffered saline alone for prepared control sample. The mixture sample was incubated for 10 min at room temperature and centrifuged for 10 min at 3000 g as well as taken the absorbance of the supernatant at 540 nm.^[53]

In heat – induced haemolysis , isotonic buffer containing aliquots (5 ml) of the different extracts were put into two duplicate sets of centrifuge tubes. Two tubes were prepared with same amount of vehicle and another tube as control. Erythrocyte suspension was added to each tube and mixed gently by inversion . One pair was maintained at (0 – 5) of a water bath. The vehicle and Erythrocyte suspension containing mixture was centrifuged for 3 min at 1300 g and the absorbance of the supernatant was determinate at 540 nm . The acceleration of hemolysis or percentage inhibition tests was calculated according to the % inhibition of hemolysis.^[53]

ANTIMICROBIAL ACTIVITY

Antimicrobial activity was carried out using agar well deffusion method.^[54] All the bacterial test organism were inoculated in nutrient broth and kept for overnight incubation at 37⁰ C where as all the fungal test strains were inoculated in Potato Dextrose Agar (PDA) (pH 7.4) for 8 hours .The antimicrobial activity of the extract was determined by measuring the diameter of zone of inhibition (mm) at the of the incubation period.^[55]

ANTI-INFLAMMATORY ACTIVITY

The present investigation suggests that the membrane stabilizing activity of leaves of *Bauhinia acuminata* plays a significant role in its anti-inflammatory activity may be due to its high flavonoids and tannin content. Prevention of leakage of serum proteins and fluids into the tissue during a period of increased permeability caused by inflammatory mediators by membrane stabilizes result.^[56] Phytochemical screening demonstrates that the plant extract contain flavonoids which have been reported to possess potent anti-inflammatory property.^[57,58] The anti-inflammatory activity is may be inhibitory effect on enzymes involved in the production of the chemical mediators of inflammation and metabolism of arachidonic acid.^[59]

ANTIOXIDANT ACTIVITY

The oxidative damage within the body occurs due to the free radical chain reaction result in many disorders and also contributes to again process. Antioxidants through their scavenging power helps in preventing oxidation process.^[60-62] Plants are natural source of antioxidants. Therefore, the stem and leaf extracts were estimated for DPPH radical scavenging activity. As the aqueous stem and leaf extracts exhibited highest DPPH scavenging activity with IC_{50} values for analyzing the electron donating property of the extracts, reducing power assay was performed.^[63] Aqueous stem and leaf extracts showed promising reducing power property. Anti-lipid preoxidation assay resulted in 65% and 41% of lipid preoxidation by aqueous stem an leaf extracts.

WOUND HEALING AND SUN PROTECTIVE EFFECTS

The wound healing property of methanolic crude extract of *Bauhinia acuminata* leaves and a pure compound chrysophanol isolated from it, was evaluated in excision, incision and dead space wound models. The parameters studied included rate of wound contraction and the period of epithelialization in excision wound model. Tensile strength in incision wound model and granulation tissue dry weight in dead space model were assessed along with the histopathological examination. Chrysophanol was found to possess significant wound healing property than methanol crude extract. The effect was evident by the decrease in period of epithelialization, increase in the rate of wound contraction, skin breaking strength, granulation tissue dry weight content and breaking strength of granulation tissue. Histopathological study of the

granulation tissue showed increased collagenation when compared to control group of animals.^[64]

The sun protection for flowers of *Bauhinia acuminata* studied. On comparison it was observed that *Bauhinia acuminata* had high SPF value with antioxidant, antibacterial property. The result indicated that *Bauhinia acuminata* flowers can be used as efficient agent for UV radiation hazards.^[65]

CONCLUSION

In this article, we had discussed that the relevant phytochemical, pharmacognostic, and pharmacological properties of *Bauhinia acuminata*. The various phytochemical investigation has been revealed that flavonoids, glycosides, alkaloids, tannins, and terpenoids are present as active biological constituents which are responsible for different pharmacological action of *Bauhinia acuminata*. The present review revealed that *Bauhinia acuminata* possess various bioactive constituent and act as antibacterial, antifungal, antianxiety, antidepressant, antidiabetic, membrane stabilizing, antimicrobial, anti-inflammatory, wound healing, and sun protective agent.

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