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Guazuma ulmifolia LAM: A review for future view

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Abstract

Guazuma ulmifolia, Lam. known as West Indian elm or bay cedar, native of tropical America is been cultivated in India since a century. It contains alkaloids, tannins, saponins, flavanoids, terpenoids, cardiac glycosides and steroids. Isolation of octacosanol, taraxeroloac, friedelin-3-áoac, â-sitosterol, and Friedelinol-3-acetate in the leaves are reported. Heartwood contains kaempferol and fruit contains the sweet edible mucilage. Its essential oil is contains major compound Eugenol (10.13%). The isolation of epicatechin and procyanidins oligomers such as procyanidin B2, procyanidin B5, procyanidin C1 from bark is reported. Ethnobotanical uses of *G. ulmifolia* of the leaves, bark, fruit, root, stem bark are reported for properties like antidiarrhetic, antibacterial, anti-inflammatory, antimicrobial, antifungal astringent, depurative, diaphoretic febrifuge, emollient, hepatoprotective, Pectoral, stomachic, styptic, sudorific, refrigerant and vulnerary. The pharmacological evaluations on plant demonstrated till date are Antioxidant, Antihypertensive and Vasorelaxing Activity, Antidiabetic, Antiviral, Ant secretory, Antibacterial, Antifungal, Cytotoxicity, Gastro protective, Hepatoprotective, Neurological & Uterine stimulant activity. The purpose of this manuscript is to bring into focus the plant *G. ulmifolia* for exploring its multipurpose uses. Thus, Ethnopharmacology suggests several medicinal uses out of which antiviral, antibacterial, antidiabetic and gastro protective are yet to be scientifically proven

Keywords: *Guazuma ulmifolia* L, Bastardcedar, Kaempferol, Ethno pharmacological, Hepatoprotective

1. Introduction

Guazuma plum.ex Adans (sterculiaceae) a small genus of trees, native of tropical America, introduced into other parts of the world whose one species i.e *G. ulmifolia* Lam. syn. *G. tomentosa* commonly known as “ mutumba” or guacimo is found in Latin American countries, including Brazil, is grown in India since 100 years. It is a small moderate- sized tree, with brown uneven bark and scattered branches, cultivated in gardens and as a roadside shade tree in the warmer parts of India. It grows up to 30m in height and 30–40 cm in diameter^[1].

Leaves are distributed in an alternate pattern with two rows. They are oblong, ovate to lance-shaped, obliquely cordate, serrate margin and usually have a rough texture. The leaf has a darker green upper surface and the lower surface is pale green. The petiole are lean and 6-12mm long, and are covered with small “star-shaped” hairs^[2].

Yellow and brown coloured flowers are arranged loosely or in a branched pattern around 2.5–5 cm in length and are found at the bottom of the leaves. There are round to elliptical shaped capsular fruits with many grey colored oval shaped seeds of 3mm in length^[3].

The wood is yellowish to light brown, strong, light to medium heavy with rough surface. It is processed for furniture, panels of coaches, packing cases and slack cooperages. It is also used as fuel and for making charcoal^[2, 4].

Distribution

Guazuma ulmifolia is distributed in the Caribbean, Mexico, Central America and Colombia, Ecuador, Peru, Bolivia, Paraguay, Argentina, and Brazil. The warmer regions of India especially Karnataka and Tamil Nadu have been cultivating them since long. Indonesia has recently introduced the species into their territory.

They are native to places such as Antigua and Barbuda, Argentina, Bahamas, Barbados, Bolivia, Brazil, Colombia, Cuba, Dominica, Dominican Republic, Ecuador, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Netherlands, Nicaragua, Costa Rica, Panama, Paraguay, Peru, Puerto Rico, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Trinidad and Tobago, Virgin Islands (US). They are considered exotic species to India and Indonesia^[4].

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Taxonomical classification ^[5]

Kingdom: Plantae – plantes, planta, vegetal, plants
 Subkingdom: Viridiplantae – green plants
 Infrakingdom: Streptophyta- land plants
 Superdivision: Embryophyta
 Division: Tracheophyta – vascular plants, Tracheophyta
 Subdivision: Spermatophyta – spermatophytes, seed plants,
 Phanerogamic
 Class: Magnoliopsida
 Superorder: Rosanae
 Order: Malvales
 Family: Sterculiaceae
 Genus: *Guazuma* Mill.
 Species: *Guazuma ulmifolia* Lam. - bastardcedar

Vernacular names ^[1, 2, 5]

- Bengali: Nipaltunth
- English: Bastard cedar, bay cedar, pigeon wood, West Indian elm
- French: Bois de hêtre, Bois d'homme, Bois d'orme
- Portuguese: Bois d'orme, embira, fruta-de-macaco, mutamba, orme d'Amérique, pojó
- Spanish: Bacedar, cambá-acá, coco, contamal, cualote, guácima, Guácima cimaronna, Guácima de caballo, guácimo, guazuma, iumanasi, kamba aka guasa, majagua de toro, papayillo, tablote, tapaculo
- Tamil: Rudrasam, tenbachai, thenmaram, tubakki
- Indonesian: Jati belanda
- Hindi: Rudrakshi



Fig 1: Different parts of *Guazuma ulmifolia*

a: whole plant, b: stem and bark, c: stem and bark, d: leaf with flower, e: leaf with flower, f: leaf with fresh fruits, g: dried fruit

Ethnopharmacological uses ^[1-9]

The leaves, bark, fruit, root, stem bark have been traditionally used by herbal medicine practitioners for their following properties

Bark: The bark is the part most used. It is used to induce perspiration, as a tonic and a blood cleanser, and is employed to treat a wide range of disorders including, digestive tract problems such as kidney problems, uterine pain, venereal

disease and as an aid to childbirth, respiratory tract problems such as asthma, bronchitis, coughs and pneumonia, fever and haemorrhages. Applied externally, it is used to bath wounds, rashes and sores, to treat skin problems, including dermatosis, elephantiasis and leprosy. It is also used to treat antibacterial, antimicrobial, antiulcer, antispasmodic, astringent, antitumour, alopecia, diaphoretic agents, bruises, burns, cardio tonic, constipation, emollient, fractures, gonorrhoea, grippe, hemorrhoids, haemorrhage, hypertension, liver problems, syphilis, ulcers and uterine pain.

Fruit: The fruit in Mauritius is the mostly used remedies against elephantiasis. It is also used to treat haemorrhage, infection, diarrhea and uterine pain.

Seed: A beverage of crushed seeds soaked in water is astringent and diuretic in nature which is also used to treat cold, cough, contusions, constipation, diarrhea, dysentery, venereal disease and in various stomach troubles. It cures Anorexia, Bronchitis, gonorrhea, leprosy, asthma, high blood pressure, syphilis, baldness and indigestion. Roasted seeds in java is the official remedy used against elephantiasis.

Leaves: Leaves are used as antibacterial, antimicrobial, antiulcer, anticancer, antipyretic, antiviral, anti-inflammatory, antispasmodic, astringent, diaphoretic agents, Asthma, alopecia, blood purifier, bruises, cardio tonic, dermatitis,, dysentery, erysipelas, emollient, fevers, kidney diseases, liver diseases, skin eruptions, sores, skin diseases, ulcers and wounds.

Root: Childbirth.

Stem bark: Diarrhoea.

Microscopy

The microscopy of stem and leaves of *G. ulmifolia* has been reported for the following characters as shown in fig no. 2, 3 and 4. Transverse section of stem is circular in outline, differentiated into epidermis, cortex and conjoint, collateral open vascular bundles. The epidermis is single layered parenchyma cells covered by thick cuticle. Just beneath it two to three layered collenchymatous hypodermis and multilayered parenchymatous general cortex is present. The endodermis surrounds the vascular tissue. Vascular bundles are conjoint, collateral, open and arranged in ring. Secondary xylem is present. At the center thin walled parenchymatous pith is present. Vessels are long with scalariform thickening on lateral walls and both the end wall plates are oblique.

Leaf anatomy shows upper and lower epidermis is composed of rectangular cells with thin visible cuticle. The mesophyll tissue differentiated into palisade parenchyma and spongy parenchyma. Trichomes are present on leaves and stem they are unicellular, non-glandular and stellate. Anisocytic stomata are confined to abaxial surface ^[10].

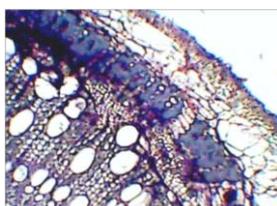


Fig 2: TS Stem

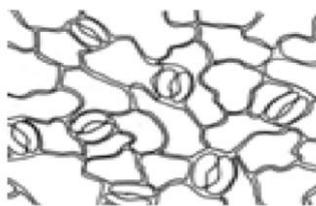


Fig 3: Stomata
~ 206 ~



Fig 4: Trichome

Physico – chemical evaluations

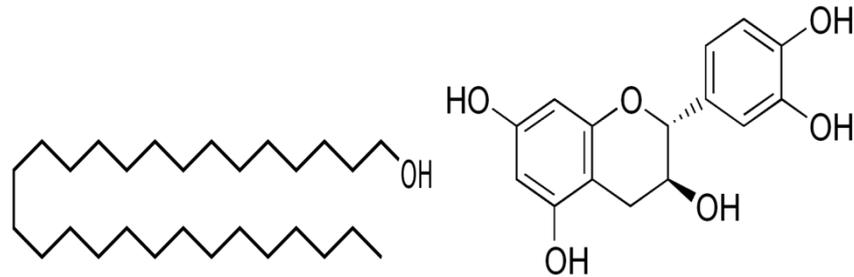
The physico – chemical constants such as Ash value, extractive value, crude fibre content, loss on drying and foaming index has been evaluated and reported. Also the author has performed the fluorescence analysis and inorganic mineral analysis of *G. ulmifolia* leaves powder. Ash analysis of the leaves resulted high sulphated ash followed by the acid insoluble ash and then water soluble ash. The water soluble extractive values are higher than the alcohol soluble extractives. The fluorescence analysis was conducted with samples extracted in hydrochloric acid, sodium hydroxide, sulphuric acid and methanol. Observations were made under visible light and under UV light of short wave length and long wave length and detected that the drug is pure since they showed their identical colors. Inorganic mineral analysis revealed the presence of high Iron (689 mg/kg), and manganese (682 mg/kg) followed by sodium (250mg/kg),

Phosphates (219), copper (120mg/kg) and then zinc (115mg/kg) contents in the leaves. Heavy metals are reported in very small quantities indicating that the drug is not toxic ^[11].

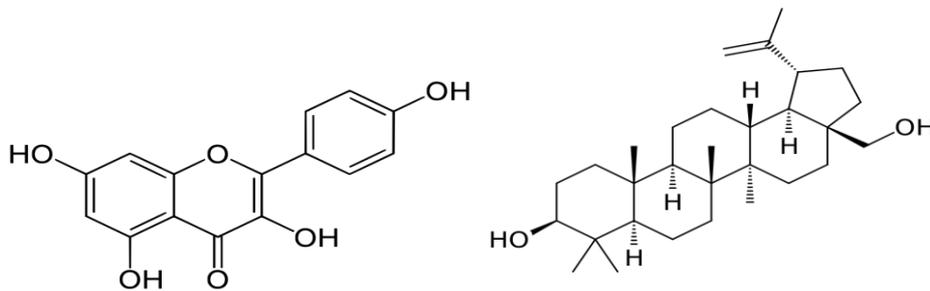
Phytochemical screening

The *G. ulmifolia* has been reported to contain the following constituents such as octacosanol, taraxerol, friedelin-3-*o*-ac, β -sitosterol, and Friedelinol-3-acetate, tartaric acid or tannins such as catechins, colatannins and caffeine in leaves, kaempferol in heartwood whereas bark contains friedelin, betulin, β -sitosterol and it is a rich source of tannins. Fruits are sweet and edible containing mucilage and contain xanthum gum, which when eaten in excessive quantities it is reported to cause diarrhea ^[6, 7].

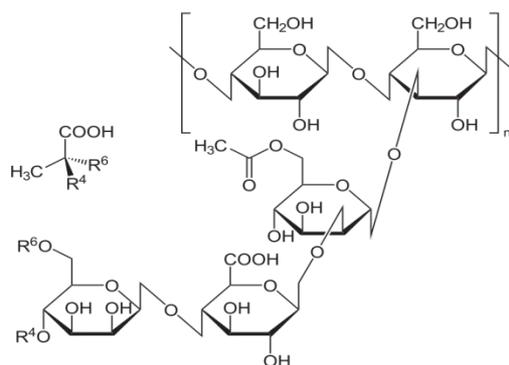
Reported chemical constituents present in *Guazuma ulmifolia* lam



Octosonal Catechin



Kaempferol Betulin



Xanthumgum

The phytochemical screening of *G. ulmifolia* of fruit and leaf shows the presence of different groups of secondary metabolites viz. alkaloids, tannins, saponins, flavanoids, terpenoids, cardiac glycosides, steroids which are of medicinal importance. Fruit has shown the absence of steroids while leaf shows the presence of steroids ^[12].

The calli culture of the *guazuma* plant has been developed. The tannins can be produced and % yield can be increased by calli culture. The result shows that there was interaction

between 2, 4-D 0.3 mg/l and Benzyl Adenin 0.1 mg/l on calli diameter (28.7 mm), the biggest calli diameter after sub culture (31.9 mm), and fresh calli weight (5.02 g) eight weeks after treatments. The tannin content observed from all of the in vitro treatments was higher (3.72 - 4.27%) than tannin from leaves collected from the plant of *G. ulmifolia* (2.24%) ^[13].

The methanolic extract of *G. ulmifolia* bark have led to the isolation of epicatechin and procyanidins oligomers such as procyanidin B2, procyanidin B5, procyanidin C1 ^[14].

The *G. ulmifolia* leaves was also isolated for essential oil by hydro distillation for 3hr. The obtained essential oil was separated, dried over anhydrous sodium sulphate, and stored under argon in a sealed vial, at 20°C before usage. The chemical compounds present in *G. ulmifolia* essential oil is eugenol (10.13%) were found as the major compounds. Other

important compounds were spathulenol (7.09%), β -caryophyllene (6.74%), sabinene (5.18%), globulol (5.56%), γ -terpinene (3.27) and α -copaene (3.17%) [15].

Tiliroside was also isolated from *G. ulmifolia* extract by chromatography method. Isolate was confirmed by liquid chromatography- tandem mass spectrometry/MS [16].

Table 1: Details of the compounds isolated and identified from different parts of *G. ulmifolia*

Sr no	Plant parts	Nature of the compound isolated	Name of the compound	References
1	Stem bark	Epicatechin and Procyanidin	Procyanidin B2, Procyanidin B5, Procyanidin C1	14
2	Methanolic extract of bark	(-)-epicatechin	flavanocoumarin epiphylloucoumarin (1) and two proanthocyanidins derivatives related to epiphylloucoumarin, epiphylloucoumarin-[4b?8]-(-)-epicatechin (2) and epiphylloucoumarin-[4b?8]-(-)-epicatechin-[4b?8]-(-)-epicatechin (3)	14
3	Leaves	Essential oil	Eugenol	15

Pharmacological evaluations of plant

Hepatoprotective activity

The ethanolic, dichloromethane (DCM) and aqueous extracts of *Guazuma ulmifolia* leaves were subjected to the evaluation for its protective effect on ccl4-induced liver damage in albino wistar rats. Serum biochemical parameters viz. serum glutamine oxaloacetate transaminase (SGOT), serum glutamine pyruvate transaminase (SGPT), serum alkaline phosphatase (SALP) and total protein (TP) were also estimated. The ethanolic and dichloromethane extracts were found to be potential source of hepatoprotective agent [17].

Antihypertensive and Vasorelaxing Activity

The in vivo and in vitro cardiovascular activity of a procyanidin fraction (PCF) obtained from acetone extract of *Guazuma ulmifolia* bark which has traditionally been used as an antihypertensive agent has been carried out. Extract of bark containing procyanidin fraction was used to test both in vitro and in vivo activity using sugar fed hypertensive rats. The result reveals decline in both systolic pressure and heart rate. Carbachol was used as a positive control during the study. Procyanidin oligomers are present in the plants which are responsible for such activity. 10 mg/kg PCF doses orally administered to sugar-fed hypertensive rats decreased both the systolic arterial pressure and the heart rate, whereas the same doses intravenously administered induced arterial hypotension which was attenuated by n-nitro-l-arginine methylester (l-name 31 mg/kg) pretreatment. In these experiments we employed carbachol as a positive control test. *Guazuma ulmifolia* bark possesses long-lasting antihypertensive and vasorelaxing properties linked to the endothelium related factors, where nitric oxide is involved [18].

Anti-Diabetic Activity

In vitro research study on *Guazuma ulmifolia* shows that this plant can be used in treatment of type-ii diabetes. Study was performed with non-toxic concentrations of *G. ulmifolia* aqueous extracts (GAE) were assayed on adipogenesis and 2-nbdglucose uptake in the murine 3t3-f442a preadipose cell line. Adipocytes and by 24% in insulin-resistant adipocytes, with respect to the incorporation showed by insulin-sensitive adipocytes stimulated with the hormone. It exerts its anti-diabetic effects by stimulating glucose uptake in both insulin sensitive and insulin-resistant adipocytes without inducing adipogenesis [19].

Gastro protective Activity

The gastro protective effects of an aqueous suspension of the ethanolic extract from leaves and flowers of *Guazuma*

ulmifolia has been reported in a model of acute gastric ulcer induced by diclofenac as ulcerogenic agent, using the proton pump inhibitor omeprazole as a protection reference. This research study shows the anti ulcerogenic effect of ethanolic extracts (125, 250 & 500mg/kg from flower and leaves of the plant using omeprazole as reference and diclofenac as ulcerating agent, on Wister rat and found extracts shows dose dependent action. The aerial parts of *G. ulmifolia* protect gastric mucosa against the injurious effect of NSAIDS mainly by anti-inflammatory and radical-scavenging mechanisms [20].

Neurological Activity

The neurological activity was tested against glutamate induced neuronal death in cultured cerebella cells containing granules. Constituent responsible for the activity was proanthocyanidin b-2 by inhibiting the flux of calcium ions. The author reported that the plant has a protective effect against transient ischemia-induced delayed neuronal death by reducing oxidative damage to neurons [21].

Antiviral activity

The anti-viral activity of methanolic leaf extract of *Guazuma ulmifolia* at 100 mcg/ml demonstrated in vitro weak antiviral activity against the herpes simplex 1 virus for their inhibitory effects on the plaque formation of herpes simplex virus-1 in vitro cells [22].

Ant secretory Activity

The ant secretory activity of *Guazuma ulmifolia* bark was examined in rabbit distal colon mounted in a chamber. Effects were studied against cholera toxin induced secretion. The stem bark was extracted using ethanol as solvent and the extract in the concentration of 40µg/ml shows the positive results [23].

Cytotoxic Activity

The vitro cytotoxicity study on human oral epidermoid carcinoma cell using leaf of *Guazuma ulmifolia* were evaluated for their cytotoxicities against human tumor cell lines, including malignant melanoma, lung carcinoma, ileocecal adenocarcinoma, epidermoid carcinoma, malignant melanoma, and medulloblastoma cell lines. Selective cytotoxicities against the melanoma cells were also observed for strictinin, peduncularis, eugeniin, elaeocarpusin, punicacortein C, casuarinin, sanguin h-6, procyanidin b-2 3, 3'-di-o-gallate, procyanidin C-1 3,3',3"- tri-o-gallate, and cinnamtannin B1 with ED50 values of 1-4 micrograms/ml. All of the tannins were found to be inactive (greater than 10 micrograms/ml) against lung carcinoma (a549), ileocecal

adenocarcinoma (hct-8), epidermoid carcinoma of nasopharynx (kb), and medulloblastoma (te671) tumor cells & found 97.3 % growth inhibitions [24].

Anti-Bacterial

Bark, leaf and fruit of *Guazuma ulmifolia* have been reported for the antibacterial activity at a range of concentrations from 10 mcg - 50 mg or 10 ml - 50 ml. The ethanolic extracts have shown activity against the bacteria such as, *S. aureus*, *B. cereus*, *B. subtilis*, *M. luteus*, *N. gonorrhoea*, *E. coli*, *P. aeruginosa*, *S. dysenteriae*, *S. typhosa*, *S. pneumoniae* and *S. pyogenes*. Ethanolic extracts of bark demonstrated the greatest activity [25].

Anti-Fungal Activity

In vitro anti-fungal studies of ethanolic extracts of the bark and fruit (10 - 25 mcg), demonstrated activity against *Cladosporium cucumerinum* and *Penicillium oxalicum*. After separation of these extracts between CH₂Cl₂ and H₂O the resulting phases were also evaluated [26].

Uterine stimulant activity

The ethanolic and aqueous extracts of bark have demonstrated the uterine stimulant activity in pregnant and non-pregnant rats [27].

Contraindications

Few of the contraindications are focused for the use of *G. ulmifolia* bark. It has been documented in animal studies to have uterine stimulant activity and therefore it should be avoided during pregnancy. In an animal study, it is also reported to lower the blood pressure. In vitro studies indicate that it can inhibit angiotensin studies-2. A hypotensive person should use this plant with caution while monitoring their blood pressure accordingly [1].

Conclusion

Guazuma ulmifolia Lam. is widely distributed throughout India. The plant appears to have a broad spectrum of activity on several ailments. Various parts of plant have Documented Properties and pharmacological evaluation antidiysenteric, Antibacterial, antifungal, antihyperglycemic, antimicrobial, astringent, anti-inflammatory, antioxidant, antiulcerogenic, cytotoxic, cardiotoxic, diaphoretic, depurative, emollient, febrifuge, hypotensive, hepatoprotective, refrigerant, smooth muscle relaxant, stomachic, styptic, sudorific, vulnerary. Phytochemically plant contains alkaloids, tannins, saponins, flavanoids, terpenoids, cardiac glycosides, steroids which are of medicinal importance. The pharmacological studies reported in this review prove therapeutic value of *Guazuma ulmifolia* Lam. However, less information is available regarding clinical and toxicity properties of this plant. The stomata, trichomes, vessels and other determined characters can help in detecting adulteration. The *Guazuma ulmifolia* bark have led to the isolation of epicatechin and leaves has shown the isolation of essential oil and Tiliroside was also isolated by chromatography method. Several phytochemical studies have been reported but still it needs the progression. With availability of primary information further studies can be carried out like Pharmacological evaluation, toxicity evaluation and phytochemical screening. The plant is pre-clinically evaluated to some extent. If these claims are scientifically and clinically evaluated then only it can provide good remedies and help mankind in various ailments.

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