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Review Article

A COMPREHENSIVE REVIEW ON PHYTOCHEMICAL, PHARMACOGNOSTICAL AND PHARMACOLOGICAL ACTIVITIES OF *BOMBAX CEIBA* THORNS

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Abstract:

The current review describes the pharmacognostical investigation of Bombax ceiba thorns (Semal Kante) and formulates a new herbal preparation based on their therapeutic-phytochemical potentials. Bombax ceiba is a traditionally valued medicinal plant, reported to have antioxidant, anti-inflammatory, antimicrobial, and skin healing properties. A detailed pharmacognostical study comprising morphological, microscopic, powder analysis, and physicochemical studies was performed for the authentication of the plant material and to set a quality standard for the same. Phytochemical screening of the hydro-alcoholic extract showed flavonoids, tannins, phenolics, and alkaloids along with other bioactive principles, which account for the therapeutic properties of the plant. These bioactive constituents are a basis for the formulation of novel herbal products, wherein Semal Kante was found to possess potentials in skincare, wound healing, and anti-acne preparations. The review justifies the use of Bombax ceiba thorns as a sustainable and effective natural resource for developing standardized herbal formulations and add to the scientific validation of its traditional uses.

Keywords: Bombax ceiba, mangiferin, lupeol, flavonoids, anti-oxidant

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PLANT INTRODUCTION:***Bombax ceiba* Linn**

Bombax ceiba, also known as the silk cotton tree, is a fast-growing member of the **Malvaceae** family found in regions including northern Australia and South Asia. This tree features large red flowers and woody thorns, with leaves comprising three to seven leaflets. It has significant medicinal applications, with all parts utilized in traditional systems like Ayurveda for their therapeutic properties, including antioxidant, anti-inflammatory, and antimicrobial effects.^[1] The tree is culturally important, referred to as the "King of Forest," and is one of the five sacred trees in "Panchvati." Its phytochemical composition includes xanthones, flavonoids, and other compounds contributing to its various health benefits.^[2]



Fig 1: *Bombax ceiba* tree

Synonyms of *Bombax ceiba* L.

- 1) *Salmalia malabarica*
- 2) *Bombax ceiba malabaricum*^[3]

Vernacular names of *Bombax ceiba* L.

English	: Red silk cotton tree
Hindi	: Semar, Semul, Semal
Marathi	: Kate savor, Semul
Malayalam	: Mullilavu
Tamil	: Ilavu ^[4]

Taxonomical Classification of *Bombax ceiba* L.

Kingdom	: Plantae
Division	: Magnoliophyta
Class	: Magnoliopsida
Order	: Malvales
Family	: Bombacaceae
Genus	: Bombax
Species	: Ceiba ^[5]

PHARMACOGNOSTICAL STUDIES**Botanical description of *Bombax ceiba***

Bark: Sharp, pointed thorns that resemble cones highlight the tree's grey-brown or silver-grey bark.

Leaves: The leaves are large, glabrous, and dispersed, 5-7 lanceolate, and 10–20 cm long leaflets.

Flowers: The enormous, meaty, bright red, yellow, or orange flowers contain numerous long, thick, silky haired seeds. The flowers blossom when the tree's leaves fall.

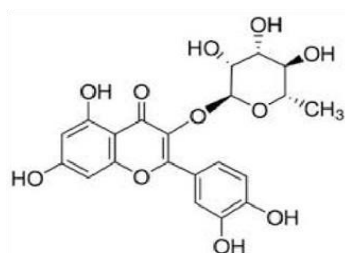
Fruits: The tree bears brown fruits that may reach a length of 55 mm and contain a lot of black seeds.

Seeds: Smooth, black or grey seeds with thick, silky hair are encased in long, white wool with an uneven, oval form.

Gum: Semul-gum is a dark brown, opaque, and transparent substance.^[6]

Fig 2. Leaf of *Bombax ceiba*Fig 3. Bark of *Bombax ceiba*Fig 4. Flower of *Bombax ceiba*Fig 5. Fruit of *Bombax ceiba*Fig 6. Seed of *Bombax ceiba***Morphological Evaluation of *Bombax ceiba* L.**

Feature	Description
Shape	Conical
Size	1-3cm
Average dimensions	18-26mm
Texture	Rough
Colour	Pale ash to grey-brown
Aroma	Nil
Taste	Nil
Base	Broad and swollen
Apex	Sharp and pointed tip

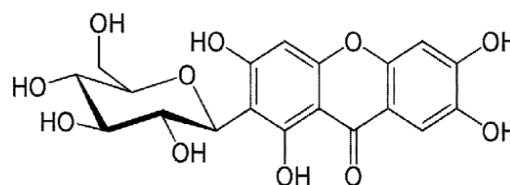


Quercetin

CHEMICAL CONSTITUENTS OF *BOMBAX CEIBA*

Bombax ceiba's rich and diverse phytochemical profile is responsible for the wide range of biological activities.

- **Flavanoids:** Quercetin, Kaempferol
- **Flavonoid glycoside:** Quercetin-3-O- β -D-glucopyranoside, Quercetin-3-O- β -D-glucuronopyranoside, Rutin (Quercetin-3-Orutinoside), Sexangularetin-3-O-sophoroside, Vitexin, Isovitexin, Vicenin-2, Kaempferol-3-Orutinoside, Kaempferol-3-O- β -D-glucuronopyranoside, Shamimin.



Mangiferin

- **Phenolic acids:** Protocatechuic acid, Chlorogenic acid, Vanillic acid, Methyl chlorogenate.
- **Phenolic glycosides:** Blumenol Cglucopyranoside, Benzyl- β -Dglucopyranoside, Phenylethyl rutinoside.
- **Coumarins:** Esculetin, Scopoletin, Scopolin, fraxetin
- **Xanthones:** Mangiferin, Iso-mangiferin, 7-methyl mangiferin
- **Anthocyanins:** Anthocyanin
- **Terpenoids:** Lupeol, 7-Hydroxycadalene^[7]

TRADITIONAL USES OF *BOMBAX CEIBA*

Sl no.	Plant part	Traditional use
1.	Thorn	Cure pimples
2.	Petals	Softens and brightens skin
3.	Bark	• The bark's decoction is taken on an empty stomach to treat dysentery and diarrhoea. • Applying bark paste to afflicted regions helps heal wounds and cuts. A bark infusion is used to cure toothaches.
4.	Leaves	Used to purify blood.
5.	Flowers	• Flowers have cooling and astringent properties Flower decoction cures leprosy, syphilis, and palate ulcers.
6.	Fruits	• Dried tender fruits are beneficial for treating diseases related to calculi • They are also effective in managing chronic kidney and bladder inflammation and ulceration.
7.	Seeds	• External use of seed paste to treat a variety of skin conditions
8.	Roots	• Roots have tonic and diuretic properties. • Used to treat coughs, cholera, and tubercular fistulas
9.	Stem	• Stem pulp is used as a cooling agent in cooling therapy.
10.	Gum	• Possesses tonic, demulcent, and astringent properties. • Utilized for treating hemoptysis related to pulmonary tuberculosis. • Effective in addressing diarrhoea^[8]

MICROSCOPY AND POWDER CHARACTERISTICS OF *BOMBAX CEIBA***Microscopy of thorn of *Bombax ceiba*:**

The sections of thorn were taken using sharp blade and stained with various staining reagents like Phloroglucinol- HCL, iodine, safranin and observed under microscope.

- I. **Parenchymatous cells:** Thick-walled parenchymatous cells are frequently observed in the xylem.
- II. **Starch grains:** Abundant, tiny starch grains of various sizes.
- III. **Stone cells:** Prominent, polygonal, thick-walled cells that provide mechanical strength.
- IV. **Cork cambium:** There were brick or polygonal cork cells that had been impregnated with layer and suberin.
- V. **Phloem cells:** mostly parenchymatous
Cortex: hard, thick-walled, heavily lignified cells that seemed polyhedral or isodiametric. Because thorn contains a lot of tannin, it has a dark-reddish brown colour.^[9]

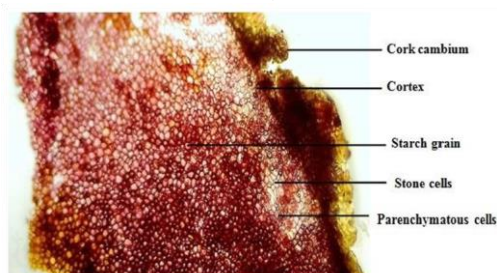


Fig7: Transverse section of thorn of *Bombax ceiba*

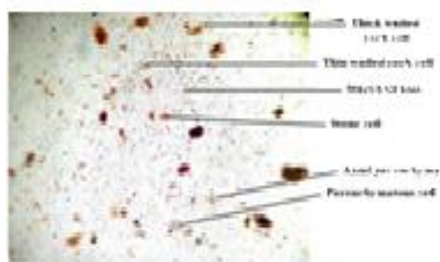


Fig 8. Powder microscopy of thorn of *Bombax ceiba*

POWDER CHARACTERISTICS OF *BOMBAX CEIBA* THORNS

The powder of thorn were taken and stained with staining reagents like Phloroglucinol- HCL and observed under microscope.

PHARMACOLOGICAL ACTIVITIES OF *BOMBAX CEIBA*➤ **Anti-obesity:**

Due to the presence of the active lupeol and flavanoids in the extract of *Bombax ceiba* Linn stem bark, obesity was induced against a high-fat diet, perhaps as a result of FAS modification and in Wistar rats signaling PTP-1B.^[10]

➤ **Anti-microbial activity:**

Bombax ceiba methanol extracts have demonstrated potent antibacterial action. Plant materials were gathered, homogenized, cleaned, and dissolved in acetone and methanol, two organic solvents. Piperacillin and amikacin, two

common antimicrobials, methanol, two organic solvents. Piperacillin and Amikacin , two common antimicrobials, were used to compare performance. Agar disk diffusion is used to provide antibacterial activity against pneumonia and Klebsiella.^[11]

➤ **Hypotensive and hypoglycemic activity:**

Shamimin and lupeol [lup-20(29) en-3b-ol], which has a potent hypotensive function. It was extracted from bark of the ceiba head. BCBMM [filtrate of BCBM (Methanolic extract of defatted stem bark)] which is the most active part has recorded negative impact on the liver, kidneys and heart of mice with the dosage being 1000 mg/kg/d.^[12]

➤ **Antiangiogenic activity:**

Examined the cells for cytotoxicity against SK-MEL-2, A549, as well as the antiangiogenic activity for B16-F10 cells. Lupeol demonstrated

a substantial inhibitory action, with an inhibition rate of 80 percent or higher at 50 µg/mL in an in vitro HUVEC tube.^[13]

➤ **Hepatoprotective activity:**

The therapeutic effects of aqueous methanol were examined against hepatic steatosis using an extract from *Bombax ceiba* flowers.^[14]

➤ **Cytotoxicity:**

Benzopyrene has been demonstrated to have protective effects on cytotoxicity in HT1080 cells in a methanolic flower extract of *Bombax ceiba*. Two derivatives of ascorbic acid and four butyrolactones were extracted, and the estimated active components were examined. 16 extract components of mangiferin. Certain isolated substances, including quercetin, kaempferol, and butyrolactone derivatives, decreased the cytotoxicity caused by BaP.^[15]

➤ **Analgesic activity:**

The analgesic effect of Methanol extract from *B. Ceiba* leaves and their fractions and mangiferin have generated analgesic effect that is dosage dependent on acetate and hot plate tests.^[16]

➤ **Anti-diabetic activity:**

The BCE's anti-diabetic action may be attributed to antioxidant activity triggered by isoorientin, vitexin, isomangiferin, quercetin, hexoside, mangiferinisovitexin, and nigricanside. Rats with type 2 diabetes mellitus (T2DM) were used in a study to examine the possible therapeutic effects of a standard extract of *B. Ceiba* leaves (BCE), and the results were noted.

In the T2DM rats, BCE significantly reduced fasting blood glucose concentrations and enhanced oral glucose tolerance. BCE demonstrated outstanding hypoglycemic effects in rats with type 2 diabetes.^[17]

➤ **Diuretic activity:**

A diuretic medication including urea (1000 mg/kg p.o.) and frusemide (25 mg/kg p.o.) was used to examine diuretic activity. After five to twenty-four hours of oral administration, the total volume of extracts is reported along with the amount of potassium, sodium, and chloride excreted in the urine. Compared to the control group, ethanolic extract (200 and 400 mg/kg, p.o.) significantly improved total urine volume and electrolyte excretion.^[18]

➤ **Antioxidant activity:**

The ethanolic extract's IC₅₀ value for DPPH activity was determined to be 94.66±0.049 (µg/ml). In contrast to the standard, which had an IC₅₀ value of 91.53 ± 0.31, the aqueous extract had an IC₅₀ value of 100.46 ± 0.36.^[19]

CONCLUSION:

The present review highlights the enormous pharmacognostical, phytochemical, traditional, and pharmacological significance of *Bombax ceiba* Linn., a medicinally significant tree commonly utilized in traditional medical systems. Its accurate identification and authentication are supported by detailed botanical, microscopic, and powder properties, which are crucial for the quality control of herbal formulations. Flavonoids, xanthones, phenolic acids, coumarins, and terpenoids are just a few of the plant's many bioactive components that together support its wide range of biological activity. Various conventional claims about *Bombax ceiba*, including as its antioxidant, antibacterial, anti-diabetic, hepatoprotective, analgesic, anti-obesity, diuretic, and anti-angiogenic qualities, have been scientifically confirmed by experimental research. Its medicinal potential is highlighted by the presence of powerful chemicals as mangiferin, quercetin, kaempferol, lupeol, and shamimin. All things considered, *Bombax ceiba* is a useful medicinal plant with a great deal of potential for creation of secure and efficient herbal remedies. In order to find lead compounds for medicinal development, future prospects include the methodical isolation, characterisation, and quantification of bioactive phytoconstituents utilizing sophisticated analytical techniques. Further formulation development, stability studies, and in-vitro/in-vivo studies are advisable to ascertain safety and efficacy.

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