



Ethanomedicine and Pharmacology of Semal (*Bombax ceiba* L.)- A Indian Medicinal Plant: A Review

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ABSTRACT

Bombax ceiba L. is valuable herb in the ayurvedic and traditional systems of medicine. In traditional system of drugs various plant parts and exudates are used as medicine. On the basis of literature survey, plant is found to be beneficial as astringent, cooling, stimulant, diuretic, aphrodisiac, demulcent, dysentery, tonic and also useful in the treatment of asthma, diarrhea, wound healing, leucorrhea, anemia and tuberculosis. Apart from these, it is also reported as anti-inflammatory and hepatoprotective, anticancer and anti-HIV activity, anti-helicobacter pylori activity, antiangiogenic activity, analgesic and antioxidant activity, inhibitory effects on tube-like formation of human umbilical venous cells, hypotensive, hypoglycemic activity, cholinesterase and antimicrobial activity. This review is an attempt to discuss the various pharmacognosy, ethnomedicinal, pharmacology and traditional uses along with reported phytochemical and pharmacological activities of *Bombax ceiba*.

Key words: *Bombax ceiba*, Kapok, Red silk.

Since prehistoric times, humans used natural products, such as plants, animals, microorganisms and marine organisms, as medicines to alleviate and treat diseases. According to fossil records, the human use of plants as medicines may be traced back at least 60,000 years (Haidan *et al.* 2016). Herbal drugs are traditional method of treating the diseases worldwide and plant which have ability to treat diseases are known as medicinal plant. Several types of medicinal plants are breathing in the nature and effective in different type of diseases (Garg *et al.* 2011). Herbal medicines are now in great demand in the developing world for primary health care not because they are inexpensive but also for better cultural acceptability, better compatibility with the human body and minimal side effects (Sanjoypal *et al.* 2002).

Bombax ceiba L. is considered to be a member of Panchwati, place where five spiritual trees are planted together to be psycho-spiritual meditation. Almost every part of the plant is reported to be useful in a variety of disorders of human. Scientific researchers worldwide have shown that it possesses hypotensive, anti-hyperglycemic, anti-hyperlipidemic, antimicrobial, analgesic, antioxidant, fibrinolysis enhancing and anabolic properties (Jain *et al.* 2011), painful eye diseases, chronic fever, insect bite (Elumalai *et al.* 2012). It is an anthelmintic remedy since ancient time (Rani *et al.* 2016).

This article is aim to provide an overview and recent findings in the area of research of phytoconstituents, ethnobotanical and pharmacological action present in various parts of plant.

Habitat and distribution

Bombax ceiba Linn. belongs to family Bombaceae Garg *et al.* (2011) which contains about 26 genera and nearly 140 pantropical species (Chaudhary and Khadabadi, 2012). It is a plant of the tropical, humid low lands (Jensen *et al.*

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1999). It is widely found in tropical Asia, Africa and hot, dry river valleys, savannah; at elevations below 1,400 meters in southern China (Flora of China, 1994). It is distributed throughout the hotter parts of the country (Antil *et al.* 2013). In India, it can be found at altitudes upto 1500 m. In peninsular India, the tree is very commonly seen in the dry and moist deciduous forests (Barwick *et al.* 2004).

Nomenclature of *Bombax ceiba* linn

Bombax ceiba L. belonging to the Bombacaceae has drawn much attention from systematists and consequently the species has had several names. To the genus *Bombax*, Linnaeus assigned three species- *B. ceiba*, *B. pentandrum* and *B. religiosum*. Some important synonyms for the species are *Bombax heptaphyllum*, *B. malabaricum*, *Salmalia malabarica*, *Gossampinus rubra*, *G. heptaphylla* and *G. malabarica*. In India the plant is known as the red silk-cotton tree to distinguish it from *Ceiba pentandra*, the real silk cotton (Kapok or white silk cotton) tree (Davis *et al.* 1996).

Morphology

This tropical tree has a straight tall trunk, with a spreading crown (Barwick *et al.* 2004). The straight, cylindrical bole is

usually very spiny, it has prominent buttresses and can be 80 cm in diameter and free of branches for 20 meters or more (Jensen *et al.* 1999). The leaf as the most valuable medicinal organ may also play important roles in traditional medicine (Aguoru *et al.* 2015). The leaves are palmate with 6 leaflets radiating from a central point, 7-10 centimeters wide, 13-15 centimeters in length along with long flexible petiole. Cup-shaped flowers solitary or clustered, axillary or subterminal, fascicles at or near the

ends of the branches. Staminal tube is short, more than 60 in 5 bundles. Stigma is light red, up to nine centimeters in length, ovary is pink, 1.5-2 cm in length, with the skin of the ovary covered in white silky hair at 1 mm long. Seeds are numerous, long, ovoid, black or gray in color and packed in white cotton. The fruit, 13 centimeters in length, is light-green in color in immature (Brown, 2011). Red flowers with 5 petals appear in the spring before the new foliage (Garg *et al.* 2011).



Tree of *Bombax ceiba* Linn.



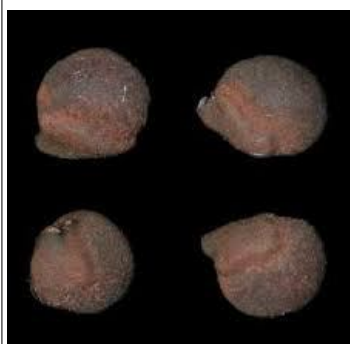
Trunk of *Bombax ceiba* Linn.



Leaf of *Bombax ceiba* Linn



Kapok of *Bombax ceiba* Linn



Seeds of *Bombax ceiba* Linn



Flowers of *Bombax ceiba* Linn



Fruits of *Bombax ceiba* Linn

Taxonomical classification

Kingdom: Plantae
 Division: Magnoliophyta
 Class: Magnoliopsida
 Order: Malvales
 Family: Malvaceae (Bombacaceae)
 Genus: Bombax
 Species: ceiba
 Binomial name: *Bombax ceiba* L.
Bombax malabaricum D.C.
Salmaia malabarica (DC.) Schott and Endl.

Range

E. Asia-southern China, Indian subcontinent, Myanmar, Thailand, Laos, Vietnam, Malaysia, Indonesia, Philippines to Papua New Guinea and Australia.

Cultivation

Propagation

The seeds are sown fresh without pre-treatment. The germination rates can be improved by pre-soaking the seeds for 12 hrs. prior to sowing, it helps for to seeds that have dried somewhat. Seeds can be sown in a sunny position, either in situ or in nursery beds. Sprouting takes place within 10-25 days. Transplant 5 cm tall seedlings to individual containers. After 12 months, cuttings of half-ripe wood have done (Anonymous, 2008).

Climate

It can grow best on deep sandy loams or other well-drained soils, especially in valleys, in the regions that are receiving 50 to 460 cm. annual rainfall well distributed throughout the year Parrotta *et al.* (2001) and annual daytime temperatures are within the range 28-42°C, though it can tolerate 5-49°C. It prefers pH in the range 5.5-6.5, tolerating 4.9-7.2. The plant is fast-growing plant, especially when young. The plant can commence flowering when around 8-10 years old. The plant produces suckers, especially when young, though they often die after 2-3 years. Young trees can be coppiced, but older trees will often fail to grow back after being cut down. The tree has a thick bark which acts as insulation and allows it to recover from fires (Ken, 2014).

Pest, Insect and its treatment

Semal shoot-borer

Semal (*Bombax ceiba*) is an important indigenous softwood species. The plant suffers severe damage by the shoot borer (*Tonicaniviferana* Wlk. Lepi., Oecophoridae). The young larvae bores in at a leaf axil and excavate a tunnel down the center of the shoot during the growing seasons.

Treatment

Application of granular formulation of Carbofuran at 85 gm/seedling or Sevidol 4:4 C (4.1% cerbaryl and 4.0% lindane)

at 50 g/seedling causes mortality of boring larvae Sen and Sharma (1986).

Part used

Fruits, heart wood, stem bark, gum and root (Hakeem, 2002).

Uses

Almost every part of plant is used as medicine, its roots and flowers are used for curing numbers of ailments (Anonymous, 1985). The flowers are used to treat cutaneous trouble. The young roots are diuretic and tonic. They are used to treat cholera, cough and urinary complains and abdominal pain due to dysentery and impotency. The gum is used to treat dysentery, hemoptysis in pulmonary tuberculosis and menorrhagia. The leaves are hypotensive and hypoglycemic. Decoctions of shoots have been used to treat ulcers of the palate, syphilis, leprosy and snake bites. The stems is used on bleeding gums. The bark is used to treat cholera, pleurisy and as diuretic. It is used in bandages for lasting fractures or given as infusion for toothache before visiting the dentist (Anonymous, 2008). It is the large and long-living tree that provides strength to body, mind and heart (Wahab *et al.* 2012).

Uses from NIF database

Pimples: Apply a paste of thorn with milk for seven days.
 Wound: Apply the fresh bark paste topically.
 Diarrhea: Take a spoonful of leaf juice along with some sugar for four days.
 Constipation: Take the bark powder (3 g), coriander powder and jiggery with water.
 Piles: Take the root paste (10 g) with water for seven days.
 Urinary disorder: Take decoction (10 ml) of the semal bark and palash flower mixed in 2:1 ratio.
 Gynecological disorder: Take the root juice orally.

Uses described in literature

Decoction of bark is given orally to combat fever. Diabetics should take decoction of the heartwood. Bark juice is given to reduce stomachache. Product 'Acne-n-Pimple Cream' is prepared from Bombax along with other plants to treat pimples and skin eruptions. 'Evecare' a multi herb product made from this plant, has a regularizing influence on the menstrual cycle (Anonymous, 2000).

Medicinal uses in ethano-medicine

Fruits

Fruit is cooling, diuretic, tonic, aphrodisiac, expectorant, blood purifier and good for leprosy. It has great beneficial effects on membranes of genitor-urinary organs, it is used for chronic inflammation of bladder, kidney and for calculus affections.

Flowers

The flowers are bitter, acrid cooling, astringent to the bowels, removes bile and phlegm, benefit the spleen and good for

leucorrhea. It is topically applied to skin infections as cooling and astringent.

Leaves

It is applied topically as a paste to relive inflammation as well as given in the form of decoction.

Bark

Stem bark is sprinkled topically in bleeding wound and applied as a paste in water to skin eruptions, boils, acne, pimples etc. Aqueous extract with curd is given for dysentery with blood.

Gum

The gum is acrid, astringent, demulcent, tonic and removes black bile. In powder form single or combined with other herbs. It is used internally to treat diarrhoea, bleeding piles, menorrhagia, leucorrhea, spermatorrhoea and blood disorders. Topically it is applied as dermatological ailment on burn wounds.

Root

The root is sweet, slightly diuretic and astringent to bowels. It is useful in biliousness, inflammations and excessive heat of the body. It is also employed in low vitality and debility (Jain and Verma, 2014).

Ethanobotanical studies

Abortifacient

Oraon tribe of West Bengal use preparation of 30 g of seed powder of *Bombax ceiba* and about 10 g Hing (*Ferula foetida*) as an abortifacient (Mitra and Mukherjee, 2009).

Sexual debility and rejuvenator

Alcoholic extract of *Bombax ceiba* bark and flower was given for 3 days in various sexual diseases like gonorrhea leucorrhea and menstrual disorders in women and to increase sperm count, treat impotency and hydrocele in men. Another study showed that bark, flower and root barks powder of plant are also used in these disorders. Apart from these sexual diseases, plant is also used to regularize menstruation and urinary problems (Jain *et al.* 2004). Kandha tribe of Orissa uses fresh stem bark juice of *Bombax ceiba*, fresh root juice of *Asparagus racemosus*, powder of seven black peppers and one teaspoon of sugar or gum taken orally before meals twice a day for 21 days to cure impotency, spermatorrhea, sterility, nocturnal emission, gonorrhoea and leucorrhea (Behera and Misra, 2005). Another ethno-botanical study showed an infusion of the bark of plant is used as a tonic (Sebastian and Bhandari, 1984).

Anti-inflammatory activity

Lohit community of Arunachal Pradesh uses fresh paste prepared from the bark of *Bombax ceiba* mixed with cow dung applied to back muscle of leg at night to treat hotness and inflammation (Namsa *et al.* 2009).

Asthma and small-pox boils treatment

Tribes of the Sonbhadra district in Uttar Pradesh use 10 g of root powder of *Bombax ceiba* with a glass of milk as a tonic to treat impotency. One spoonful powder of stem with a glass of cow's milk or fresh water was taken every morning for 3-4 months to treat asthma. Blisters due to small-pox were treated with local application of seed paste prepared in water (Singh *et al.* 2002).

Wounds healing activity

The bark paste is used for cattle wounds topically (Kshirsagar and Singh, 2001). Field observations in three villages in Nawalparasi district of central Nepal showed that local application of bark juice is used for the treatment of wounds (Ghimire and Bastakoti, 2009).

Anti-diarrhoea activity

Tharu people drink the bark juice of *Bombax ceiba*, *Mangifera indica* and *Psidium guajava* mixed together to cure dysentery and intestinal spasm. The bark exudates are also taken orally to treat worms and diarrhoea (Ghimire and Bastakoti, 2009). The native people of Mizoram state use decoction of *Bombax ceiba* leaves and *Mangifera indica* bark twice a day orally to treat diarrhoea (Sharma *et al.* 2001). People of Parinche valley, Pune, Maharashtra use paste of inner part of root at morning, preferably before meals for 2 days to treat diarrhoea (Tetali *et al.* 2009).

Leprosy treatment

Seeds and roots of *Bombax ceiba* were used by traditional practitioners and religious healers of Bangladesh in the treatment of leprosy (Mollik *et al.* 2009).

Dermatological disorders

The tribal communities of North-West Frontier Province of Pakistan employ *Bombax ceiba* in the treatment of skin diseases and in folk cosmetics. For this purpose, crushed fresh *Bombax ceiba* bark was applied locally on pimples, carbuncles and boils (Abbasi *et al.* 2010). Pawara tribal people in the Satpuda hills of Maharashtra apply concentrated bark decoction of plant in treatment of dermatological disorders. They also used decoction plant bark given orally twice a day for 7 days to treat leucorrhoea (Kosalge and Farsule, 2009).

Anthelmintic drug

Flowers of *Bombax ceiba*, 25-50 g were fed to animals as anthelmintics in southern Punjab, Pakistan by the herdsmen (Jabbar *et al.* 2006).

Red eye treatment

A paste of petals is mixed with breast milk and is applied externally to cure "red eyes" (Reddy *et al.* 2008).

Waist pain

The *B. ceiba* root is used as a tonic to heal waist pain (Srivastava 2007). The root tubers have high calcium content (Ghate *et al.* 1988).

Miscellaneous uses

In Eastern Rajasthan tender twig is used as a toothbrush to cure mumps and powdered flowers with honey to treat menorrhagia. Thorn paste with unboiled milk can be applied for 5-6 days on the face to treat acne. The thorn was chewed to cure mouth sores. The roots powdered with those of *Chlorophytum*, *Capparis sepiaria* and fruits of *Pedaliu murex* were taken with water as a tonic for 7-8 days to calm body heat. Root bark extract was given as a nervine tonic. Root powder mixed with sugar and milk was taken to avoid impotency (Upadhyay *et al.* 2010).

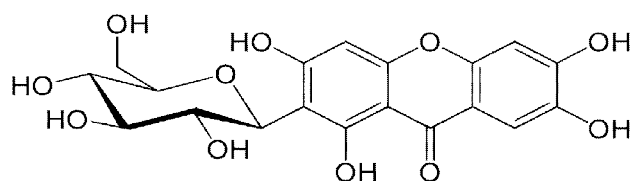
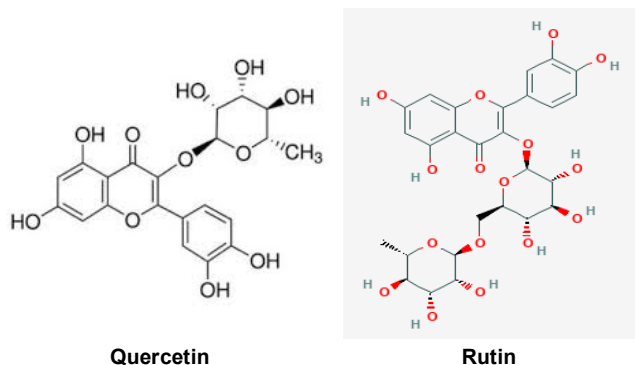
Phytochemistry

Bombax ceiba flowers contains β -D-glucoside of β -sitosterol, free β -sitosterol, hentriacontane, hentriacontanol, traces of an essential oil, kaempferol and quercetin as phytoconstituents. Shamimin, a newly discovered flavonol C-glycoside, a pale-yellow powder from the ethanol extract of fresh, not dried leaves of *Bombax ceiba* (Verma *et al.* 2014).

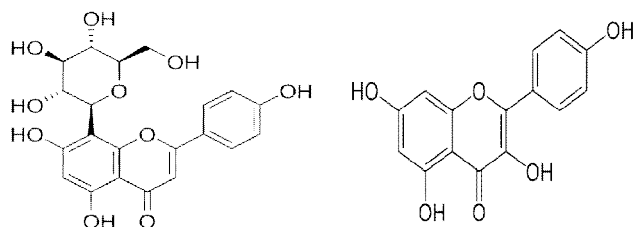
Three new phenolic compounds were isolated from the flowers of *Bombax malabaricum* (Yu-Bo *et al.* 2015). Tannins present in plants (Iroka *et al.* 2014). From the flowers of *Bombax ceiba* L. twenty-four compounds were isolated and identified, including ten flavonoids, quercetin (1), quercetin-3-O- β -D glucopyranoside (2), quercetin-3-O- β -D-glucuronopyranoside (3), rutin (4), sexangularetin-3-O-sophoroside (5), vitexin (6), isovitexin (7), viciin 2 (8), kaempferol-3-O-rutinoside (18) and kaempferol-3-O- β -D-glucuronopyranoside (23); three xanthones, isomangiferin (9), mangiferin (10) and 7-O-methyl mangiferin (11); four coumarins, esculetin (12), scopoletin (13), fraxetin (14) and scopolin (21); and seven other compounds, blumenol C glucopyranoside (15), benzyl- β -D-glucopyranoside (16), phenylethylrutinoside (17), protocatecholic acid (19), chlorogenic acid (20), methyl chlorogenate (22) and vanillic acid (24) (Joshi *et al.* 2013).

The phytoconstituents like flavanoids, terpenoid saponins, carbohydrates, tannins and glycosides are present in the flower extracts (Hait and Goswami, 2017). The presence of glycosides and tannins in roots, stem and leaf also reported. In the stem some alkaloids and in roots, proteins are identified. The stem bark and root contain mangiferin, lupeol and β -sitosterol. The root bark has 3 naphthalene derivatives related to gossypol (semigossypol), toxic principle of cotton seed (Chaudhary *et al.* 2014).

Chemical structure

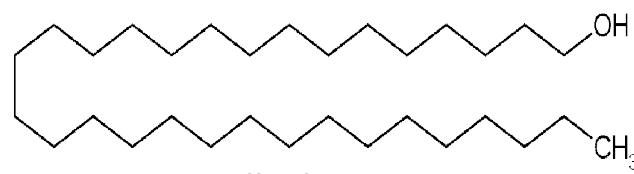


Magniferin

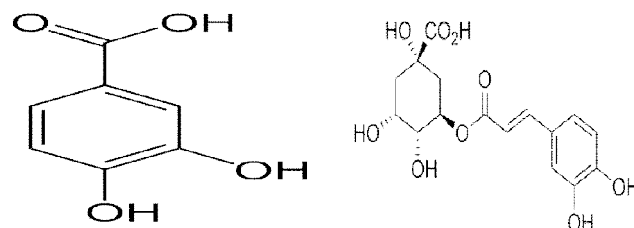


Vitexin

Kaempferol



Hentriacontane



Protocatecholic acid

Chlorogenic acid

Pharmacology

Antioxidant activity

The methanolic extract of *Bombax ceiba* using several antioxidant assays evaluated and reported that extract showed significant antioxidant activity in all assays and showed very low toxicity toward Vero cells (Vieira and Said, 2009). Further study on aqueous and ethanolic extracts of bark of *Bombax ceiba* (Bombacaceae) by using *in vitro* antioxidant activity screening models and ascorbic acid as standard drug found that the extracts showed potent antioxidant activity (Gandhare *et al.* 2010). The methanol extract of *Curcuma longa*, *Bombax ceiba*, *Ficus bengalensis*, *Lensculinaris* were evaluated for anti-bacterial and antioxidant and observed that different fractions significantly reduce DPPH free radicals in a dose dependent manner (Raj *et al.* 2016). Researcher also evaluated and concluded that the methanolic extract of roots of *Bombax ceiba* has antioxidant activity due to the higher percentage of phenolic compounds and tannins. Further in healthy human volunteers a significant increase in total antioxidant level

was noted after 4 hours of taking 3 gm of root powder (Jain *et al.* 2011).

Hepatoprotective and antioxidant activity

The aqueous extract of flowers of *Bombax ceiba* (BCAE) showed hepatoprotective effect and exhibited *in vitro* antioxidant effects (Manish *et al.* 2016). The antioxidant and antihemolytic activities of spike and young fruit aqueous, methanol, chloroform and ethyl acetate extracts of *Bombax ceiba pentandra* reported that among all the four extracts, methanolic extract exhibited significant activities (Divya *et al.* 2012).

Antioxidant and choline esterase inhibitory activity

Cholinesterase and antioxidant activity of hexane and ethanol extracts of *Bombax ceiba* flowers investigated and noted that the extracts have antioxidant potential and also inhibited the cholinesterase effectively (Sinha *et al.* 2018).

Anti-anxiety activity

Anti-anxiety potential of ethanol extracts of *Bombax ceiba* leaves on rats concluded that the extract at higher dose significantly increased the time duration and number of entries into the open arm compared to the control group and at low dose results were statistically insignificant (Alsayari *et al.* 2018).

Anti-inflammatory activity

Ethanol extract of *Bombax ceiba* barks showed significant response and has potential to reduce inflammation (Anandarajagopal *et al.* 2013).

Analgesic and antioxidant activity

Mangiferin, isolated from methanolic extracts of *Bombax ceiba* leaves has strong antioxidant activity and also showed hepatoprotective activity. Additionally, plant extracts and mangiferin failed to exhibit acute anti-inflammatory activity (Dar *et al.* 2005). Plant extract showed significant analgesic effect in mice. This analgesic effect was independent to opioid receptor but Mangiferin has significant interaction with the receptor at a peripheral site, with a slight contribution at the neuronal level (You *et al.* 2003).

Antidiabetic and hepatoprotective activity

The ethanolic extract of young roots of *B. ceiba* have potential hypoglycemic, hypolipidemic and hepatoprotective activity (Sharmin *et al.* 2018).

Antidiabetic activity

The standard extract of *Bombax ceiba* L. leaves (BCE) exhibited an excellent hypoglycemic activity and alleviated dyslipidemia (Guang Kai *et al.* 2017).

Hypoglycemic activity

Hypoglycemic activity of ethyl acetate, n-butanol and hydroalcoholic extract of leaves of *Bombax ceiba* Linn on Normoglycemic rats model and Oral Glucose Tolerance Test model evaluated and reported that all the extracts showed significant hypoglycemic activity compared to standard drug

but hydroalcoholic extract are superior to other in dose dependent manner (Bhargava and Shah, 2016).

A novel constituent, Shamimicin, a C-flavonol glucoside from *Bombax ceiba* leaves showed significant hypotensive potency Saleem *et al.* (1999). In further study researcher isolated and studied the hypotensive and toxicological activities of shamimicin, 1''', 1''''''-bis-2-(3,4-dihydroxyphenyl)-3,4-dihydro-3,7-dihydroxy-5-O-xylopyranosyloxy-2H-1-benzopyran and lupeol constituents from *Bombax ceiba* stem bark and concluded that low doses of this can be useful in reducing blood pressure safely (Saleem *et al.* 2003).

Anti-osteoporotic activity

Osteogenic activity *in vitro* and anti-osteoporotic activity *in vivo* of petroleum ether and methanol extracts of *B. ceiba* stem bark in surgical ovariectomy model in female rats studied and observed significant osteoblast cell proliferation and alkaline phosphatase activity of extracts in UMR-106 cell lines. Also reported that administration of petroleum ether and methanolic extract for 28 days significantly ameliorated the consequences of ovariectomy induced bone porosity and restored the normal architecture of bone (Chauhan *et al.* 2018).

Diuretic activity

The diuretic effects of aqueous and ethanol extracts of *Bombax ceiba* L. fruits studied and concluded that both extracts significantly increased urine output in higher doses. Aqueous extract also caused marked increase in urinary Na⁺ and K⁺ levels (Jalalpуре and Gadge, 2011).

Antioxidant and Immunomodulatory activity

The methanol extract of *Bombax ceiba* possessed promising immunostimulant properties which could be ascribed, in part, to its anti-oxidant capacity (Wahab *et al.* 2014).

Nephrotoxicity activity

The ethyl acetate, n-butanol, aqueous extract of *Bombax ceiba* was investigated for its protective effects on gentamicin-induced renal toxicity in rats and reported that n-butanol and aqueous extracts protected the rats from alteration in serum levels of urea, creatinine, MDA (Malondialdehyde) better when co-administered with gentamicin through reversing the mild tubular necrosis than severe tubular necrosis (Vasita and Bhargava, 2014).

Antiangiogenic activity

The methanol extract of *Bombax ceiba* stem barks was found to exhibit a significant antiangiogenic activity on *in vitro* tube formation of human umbilical venous endothelial cells. Lupeol showed a marked inhibitory activity on HUVEC tube formation while it did not affect the growth of tumor cell lines such as SK-MEL-2, A549 and B16-F10 melanoma (Nam *et al.* 2003).

Anti-hyperlipidemic effect

The bark and seeds powder of *Bombax ceiba* have antihyperlipidemic activity on high fat high cholesterol (HFHC) fed rats group (Singh *et al.* 2018).

Antimicrobial and antibacterial activity

Multi-drug resistant *Salmonella typhi* was reported highly susceptible to methanol extracts of *Bombax ceiba* while acetone and aqueous extracts were less effective (Rani and Khullar, 2004). In another study methanol and acetone extracts found potent antibacterial activity against *Klebsiella pneumonia* (Vaghasiya and Chanda, 2009). Further methanolic extract of *Bombax ceiba* stem bark has broad spectrum antibacterial activity and it can also provide defense against oxidative stress (Masood-ur-Rehman and Naveed, 2017). The aqueous extracts of *Bombax ceiba* bark was more significant against Gram-positive bacteria than against Gram-negative bacteria (Digge *et al.* 2015). The *Pseudomonas aeruginosa* was inhibited by both methanol and ethanol extracts of *Bombax ceiba* stem bark. Similarly, methanol extract reduced the growth of *Bacillus subtilis*. However, ethanol extract showed a good activity against *Xanthomonas maltophilia*. Aqueous extract showed comparatively less effective against *Escherichia coli*. *Klebsiella pneumoniae* was found resistant to all of the three extracts, while the growth of *Candida albicans* was inhibited by methanol or its extract (Syed and Syed 2018).

Antimicrobial and antioxidation activity

The methanolic crude extract of *Bombax ceiba* (roots) showed mild to moderate activity against the test bacteria and zone of inhibition was depending on the concentration. They found that the tested root extracts have antioxidant activity (Jahan, 2016).

Free radicle scavenging activity

Methanolic extract of *Bombax ceiba* roots showed very good DPPH radical scavenging activity in a dose dependent manner. Acute study in healthy human volunteers showed significant rise in total antioxidant status at the end of 4 h after administration of 3 g root powder (Jain *et al.* 2011). The aqueous extract of flower exhibited significant free radical scavenging activity (Sharma *et al.* 2017).

Antipyretic activity

The methanolic extract of *Bombax ceiba* leaf has significant antipyretic activity in baker's yeast induced pyrexia in Wistar rats (Hossain *et al.* 2011).

Aphrodisiac activity

The root extract of *Bombax malabaricum* showed significant aphrodisiac activity and also increased significantly mounting frequency, intromission frequency and ejaculation frequency. These effects were observed in sexually active and inactive male mice (Chaudhary and Khadabadi, 2012).

Anti-helicobacter pylori activity

Ethanolic extract of *Bombax ceiba* has strong anti-helicobacter pylori activities (Wang and Huang, 2005).

Anti-cancer activity

Effects of mangiferin in rat colon carcinogenesis induced by chemical carcinogen, azoxymethane (AOM) were evaluated and opined that mangiferin has potential as a naturally occurring chemo-preventive agent (Yoshimi *et al.* 2001).

Cytotoxicity

Aqueous extracts of the plant *Bombax ceiba* exhibit mild cytotoxic effect in brine shrimp lethality test (Alluri and Gottumukkala, 2005).

CONCLUSION

This literature survey shows that various parts of *Bombax ceiba* Linn have been used as medicine since ancient time in traditional system of medicine. Many research scholars and scientists have worked on this plant to validate the ethano-botanical claim and found it to be true and concluded that this plant is used as abortifacient, anticancer, cytotoxicity, anti-diabetic and hepatoprotective activity. However there is still further need to identify and isolate the pharmacologically active molecules from different parts of this plant so as it can be better utilized.

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