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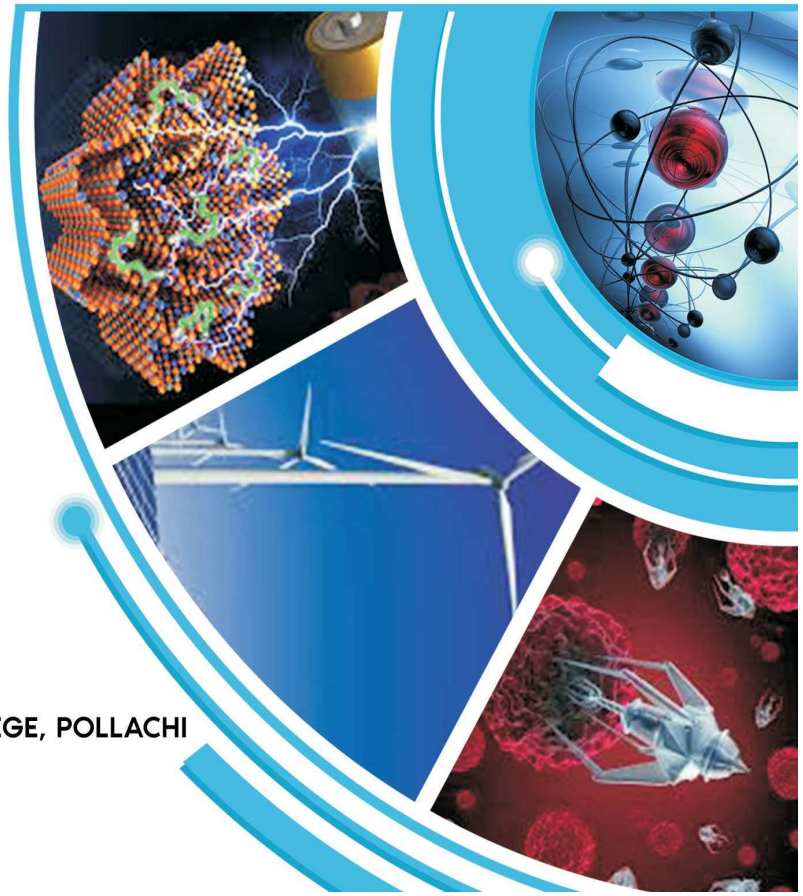

PG DEPARTMENT OF CHEMISTRY
NALLAMUTHU GOUNDER MAHALINGAM COLLEGE, POLLACHI

CONTENT

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PHYTOCHEMICAL AND PHARMACOLOGICAL STUDIES OF *BOMBAX CEIBA LINN*-AN UPDATED REVIEW

S.SARANYA AND K.POONKODI*

ABSTRACT

Bombax ceiba Linn a medical herb belonging to the Family Bombacaceae also known as red silk cotton tree widly distributed in temperate Asia, tropical Asia, Africa, Australia. Many parts of the plants (root, stem bark, gum, leaf, prickles, flower, fruit, seed and heartwood) are used by medicines, health products, pharmaceuticals, food supplements, cosmetics etc. Its medicinal usage has been reported in the traditional systems on medicine such as Ayurveda, Sidda and Unani. *Bombax ceiba Linn* is used as extensivly for treatment of some diseases like anti-inflammatory, hepato-protective, hypotensive, anti-angiogenic, antidiabetic, aphrodisiac, utrine tonicity, anticancer, anti-HIV activity, anti-*Helicobacter pylori*, antitoxicity, anticarcinogenic, immunemodulatory, hypolipidemic, antihyperglycemic, analgesic and antioxidant. It is reported to contain important phytoconstituents such as naphthol, naphthoquinones, polysaccharides, anthocyanins, shamimin and lupeol. A review of chemical constituents present in various parts of *Bombax ceiba* and their pharmacological actions is given in the present article.

Key words; *Bombax ceiba*, Bombacaceae, Ayurveda, polysaccharides, shamimin,

INTRODUCTION

Since the ancient times, nature has been a huge source of medicinal agents. All over the world, plants have served as the richest source of raw materials for traditional as well as mordern medicine[(1)]. The starting materials for about one half of the medicines we use today come from natural sources. The future of higher plants as sources of medicinal agents for use in investigation, prevention, and treatment of diseases is also very promising[(2)].

Natural products have provided us some of the important life saving drugs used in the mordern medicine. However, among the estimated 250,000-400,000 plant species, only 6% have been studied for biological activity, and 15% have been investigated phyotochemically. This shows a need for planned activity, guided phyto-pharmacological evaluation of herbal drugs[(3,4)].

Phytochemicals, also known as phytonutrients, are natural non-essential chemical compounds found in plants (phyto is a Greek word meaning “plant”). They can occur in vegetables, grains, legumes, beans, fruits, herbs, nuts, roots, leaves and seeds. Phytochemicals are compounds that give plants their color, flavor, and smell[(2)]. This artical intends to provide an overview of the chemical constituents present in various parts of Bombax ceiba and their pharmacological actions[(1)].

HABITAT AND DISTRIBUTION

Bombax ceiba contains about 26 general and 150 pantropical species. It commonly known as simbal, simul, Indian kapok, purani, pagun, roktosimul, Indian bombax or red silk cotton tree belongs to the family Bombacaceae. Which is an important medicinal plant and found widely in temperate Asia, tropical Asia, Africa and Australia.[(3)] many

part of the plant (Root, stem bark, gum, leaf, flower, fruit, seed and heartwood) are mainly used by various tribal communities and forest divellers for the treatment of wide varity of oilments.[4] In peninsular India, the tree is very common in the dry as well as moist deciduous forests and rivers. The tree is a strong light-demander, fast growing and grows best on deep sandy loams or othre well-drained soils, particularly in velleys, in regians receiving from 40-460cm annual rainfall well distributed throughout the year.[3]

It has many pharmacological activities like in-vitro Anti-inflammatory, Antinociceptive activity, Anti-diabetic, Anti-obesity, Hypotensive, Hypoglycemic, Antioxident, Antiangiogenic, Antimicrobial, Cytotoxicity, Aphrodisiac, Haemostatic, Astringent Diuretic, Cardiotonic, Demulcent, Anti-dysentric, Anti-diahorreal, Anti pyretic effects, Anti- proliferative and Anti-tumer activity.[3,4] *B.ceiba* is characterized photochemically by the presence of flavonoids, xanthones, sterols, polysaccharides, anthocyanins, shaminin, lupeol hydrocarbons, fatty acids and their esters.[5,6]

ANTI-INFLAMMATORY ACTIVITY

BCL, BCM and mangiferin at 100 mg/kg failed to exhibit detectable anti-inflammatory activity when subjected to carrageenan-induced rat paw edema, a popular screen for the evaluation of anti-inflammatory properties implying that they are devoid of acute anti-inflammatory activity[17]. Lupeol was obtained after twice extraction with petroleum ether and three times washing with methanol to give white shinning needles of the compound (m.p. 214.7°C) also posses' anti-inflammatory activity[18]. An ethnobotanical study of traditional anti-inflammatory plants used by the Lohit community of Arunachal Pradesh showed that fresh paste prepared from the bark of *B. ceiba* mixed with cow dung was applied over back muscle of leg at night to treat hotness and inflammation[19].

According to K. Anandarajagopal et al., (2013) the present study, the results have found that ethanol extract showed highly significant($p<0.001$) anti-inflammatory activity than aqueous extract ($p<0.01$) followed by petroleum ether extract ($p<0.05$). The findings of this study exemplified that the significant anti-inflammatory activity of B. ceiba extracts is due to the presence of above mentioned chemical constituents in the extracts[20].

Verma et al.,(2014) the extract of *B.ceiba* was assessed by Human Red BloodCorpuscles (HRBC) membrane stabilizing method with slight modifications. The blood was collected from healthy human volunteer who had not taken any anti-inflammatory drugs for 2 weeks prior to the experiment and transferred to the heparinized centrifuge tubes and centrifuged at 3,000 rpm. The packed cells were washed with isosaline and a 10% suspension in normal saline was made. Diclofenac potassium (50 mcg/ml) was used as standard. The reaction mixture (4-5 ml) consisted 2 ml of hypotonic saline (0.25% w/v NaCl), 1 ml of 0.15 M phosphate buffer (pH 7.4), 1 ml of test solution (1000 mcg/ml) in normal saline and 0.5 ml of 10% HRBC in normal saline. For control, 1 ml of isotonic saline was used instead of test solution. The mixtures were incubated at 56ºC for30 min. and cooled at running tap water, centrifuge at 3000 rpm for 20 min. The absorbance of supernatant was read at 560 nm using visible Spectrophotometer.

According to Emdad Hossain., et al (2013) the MEBM at a lower dose of 100 mg/kg demonstrated significant anti-inflammatory activity ($p <0.05$); improved activity was seen with 200 mg/kg($p < 0.01$) and most significant activity ($p < 0.001$)was observed with MEBM at a 400 mg/kg doserange as compared to untreated control and the maximum activity was observed at 5^{th}forall the test groups after carrageenan

injection.Indomethacin 10 mg/kg demonstrated potent anti-inflammatory activity ($p < 0.001$) maximum at 5th(75.96%). 22.53, 27.19, and 32.47% inhibition wasfound with MEBM at a dose of 100, 200, and 400mg/kg, respectively.

ANTI-MICROBIAL ACTIVITY

Shamimin a new flavonol C-glycoside has been isolated as a pale yellow powder from the ethanolic extract of fresh, undried leaves of *Bombax ceiba* showed antimicrobial activity against a few bacteria and fungi [19]Plant extracts (methanol and aqueous) were assayed for their activity against multi-drug resistant Salmonella typhii. Strong antibacterial activity was shown by the methanol extracts of Salmaliamalabarica [20].

Plant or plant parts were collected, dried, homogenized and extracted in two organic solvents viz. methanol and acetone. The antibacterial activity against Klebsiellapneumoniae was done by agar disc diffusion method. The activity was compared with standard antimicrobials Amikacin and Piperacillin [21].

M. K. Islam et al., (2011) was investigated the zones of inhibition produced by the methanol, n-hexane, chloroform and carbon tetrachloride extract were found to be 10─ 14 mm, 09 ─ 15 mm and 13 ─ 20 mm respectively, at a concentration of 200 µg/disc in case of 09 bacterial strain and 02 fungal strain but the bacterial strain of B. subtilis, S. aureus, S. boydii, S. dysenteriae and one fungal strain (Saccharromycescevevaceae) showed no sensitivity. The significant activity was found by hexane extract against Sarcinalutea(13mm) and Pseudomonasaeruginosa(12mm). The chloroform extract showed prominent activity against Vibrio mimicus (15mm); significant activity against Bacillus megaterium (12mm)andVibrio parahemolyticus (12mm). The carbon tetrachloride extract showed prominent (zone of inhibition >15mm) activity against almost all bacterial strain.

M. K. Islam et al., (2011) was investigated the Antibacterial and antifungal activity of different extracts of *B.ceiba*. The bacteria *Bacillus cereus*, *Bacillus Megaterium*, *Bacillus Sustalina Staphylococcus aureus* and *Sarcina lutea* are tested other than *Bacillus cereus* has no antimicrobial activity.

Anti-diabetic activity

A dose of 600 mg/kg of *B. ceiba* extract is the most effective to cause significant ($p<0.001$) hypoglycemic and/or hypolipidemic effects on streptozotocin-induced diabetic rats. This dose also significant-ly ($p<0.001$) lowered the total cholesterol and triglyceride level in severely diabetic rats. Phytochemical and GC-MS studies confirmed the presence of the triterpenoid compounds in the extract, which may account for its significant hypoglycemic activity.

Hypotensive and hypoglycaemic activity

Shamimin, a C-flavonolglucoside from B.ceiba leaves showed significant potency as a hypotensive agent at the doses of 15 mg/kg, 3 mg/kg, 1 mg/kg and significant hypoglycaemic activity at 500 mg/kg in Sprague Dawley rats.

Cytotoxicity

Aqueous extracts of the plants were screened for their cytotoxicity using the brine shrimp lethality test. The present study supports that brine shrimp bioassay is simple

reliable and convenient method for assessment of bioactivity of medicinal plants and lends support for their use in traditional medicine

Hepatoprotective activity

The hepatoprotective activity of a methanolic extract of flowers of B. ceiba (MEBC) was investigated against hepatotoxicity produced by administering a combination of two anti-tubercular drugs isoniazid (INH) and rifampicin (RIF) for 10 and 21 days by intraperitoneal route in rats. MEBC were administered at three graded dose i.e. 150, 300 and 450 mg/kg i.p. 45 min prior to anti-tubercular challenge for 10 and 21 days. MEBC was evident in all doses as there was a significant decrease in alkaline phosphatase (ALP), alanine transaminases (ALT), aspartate transaminases (AST) and total bilirubin levels.The results obtained from the analysis of biochemical parameters and histopathological studies, resulted in the conclusion that the MEBC were not able to completely revert the hepatic injury induced by INH and RIF, but it could limit the effect of INH and RIF to the extent of necrosis.

Analgesic activity

Mangiferin, 2-beta-D-glucopyranosyl-1,3,6,7 tetrahydroxy-9H-xanthen-9-one, obtained directly from methanolic extracts of B. ceiba leaves demonstrated strong antioxidant activity (EC(50) 5.8 (+/-) 0.96 mμg/ml) using DPPH assay. The acetyl and cinnamoyl derivatives were found to be less active than mangiferin whereas methyl and 3, 6, 7-trimethylether tetraacetate derivatives were inactive implying that for antioxidant activity, free hydroxyl groups and catechol moiety are essential. Moreover, mangiferin showed hepatoprotective activity against carbon tetrachloride induced liver injury further supporting the free radical scavenging property in the in vivo system. Additionally, crude plant extracts and purified mangiferin failed to exhibit acute anti inflammatory activity whereas, extracts displayed significant analgesic effect in acetic acid-induced writhing and hot plate tests in mice.

Anticancer and anti-HIV activity

The methanolic extract of leaves and pure compounds mangiferin and acetyl derivative of mangiferin were evaluated in National Cancer Institute (NCI, NIH, Bethesda, U.S.A.) for anticancer and anti-HIV activities. All the samples were found to be inactive as cytotoxic and as anti-HIV agent. On the contrary, inhibitory effects of mangiferin in azoxymethane-induced rat colon carcinogenesis indicated its chemoprotective nature.This discrepancy may have arisen due to the differences between the *in vitro vs. in vivo* assays used to assess the anticancer activity and thereby emphasizes the need to conduct a combination of both types of assays before reaching a definite conclusion.

Antinociceptive activity

In a study carried out with extract of the plant and mangiferin displayed significant analgesic effect in acetic acid-induced writhing and hot plate tests in mice.The results obtained in the present study demonstrated that methanolic leaf extract of *B. ceiba* and pure compound mangiferin have antinociceptive effects on the various models tested [31-38].

Anti-angiogenic activity

The methanolic extract of the stem barks of *Bombax ceiba* was found to exhibit a significant antiangiogenic activity on *in vitro* tube formation of human umbilical venous endothelial cells (HUVEC). At 50 and 30 μg/mL 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(human melanoma), A549(human lung carcinoma), and B16-F10 (murine melanoma).

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