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Review Article

Phytochemicals, bioactivities of *Bombax ceiba* Linn: A review**Khaled Rashed***

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Abstract

Bombax ceiba is commonly known as silk cotton tree which belongs to family Bombacaceae. It is an important medicinal plant of tropical and subtropical India. Its medicinal usage has been reported in the traditional systems of medicine such as Ayurveda, Siddha and Unani. It has wide range of medicinal and pharmacological application. It is used in tradition system of medicine and has diuretic, dysenteric, emetic, diarrhoeal, Wounds, Acne, skin blemish and pigmentation, Cold and cough. It has many pharmacological activities like *in-vitro* anti-inflammatory, anti-diabetic, anti-obesity, Hypotensive, Antioxidant, Antiangiogenic, Antimicrobial, Cytotoxicity, Aphrodisiac and Antipyretic. This review has pharmacological, phytochemical properties and therapeutic benefits of the plant.

Keywords: *Bombax ceiba*, chemical compounds, bioactivities.

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1. Introduction

The medicinal plants are extensively used for curing variegated malady in day to day life. There is an emergent demand for plant based medicines, food supplements, health products, pharmaceuticals etc. *Bombax ceiba* Linn. is an essential medicinal plant of subtropical and tropical India belongs to the family Bombacaceae. It is a deciduous tree attaining a height upto 40-50m and a girth more than 6 m, distributed throughout the hotter parts of the country about 1500m [1]. Also found in Africa, Australia, temperate and tropical Asia. A lofty, deciduous, buttressed tree with stout hard prickles at base, the tree attains a height upto 40m and a girth upto 6m or more having a clear hole of 24-30m, buttresses are present only in trees of about 30 years age or more. Leaflets 5-7, lanceolate, glabrous. Flowers large, bright red. Capsules woody. Seeds enveloped in copious floss [2]. The various parts of *Bombax ceiba* like leaves, roots, stem bark, seed, flower, gum and fruit are reported to possess rich medicinal components in ethnobotanical surveys conducted by ethnobotanist and in traditional system of medicine. *B. ceiba* showed that plant is utilized in the treatment of

hydrocele, leucorrhoea, gonorrhoea and to regularize menstruation, urinary problems and as a tonic [3]. It is also prescribed for increasing sperm in semen and to act as an aphrodisiac. Studies on the ethnomedicobotany of the Kandha tribe of Orissa revealed that fresh stem bark of *B. ceiba*, with some other herbs taken orally to cure gonorrhoea, impotency, spermatorrhea, sterility, nocturnal emission and leucorrhoea [4]. *B. ceiba* extract mixed with cow dung was applied over back muscle of leg at night to treat hotness and inflammation [5, 6]. The plant is one among five trees of 'Panchwati' and hence, has spiritual importance. It is the large and long-living tree that provides strength to body, mind and heart [7]. This review gave phytochemicals and bioactivities of *B. ceiba*.

2. Chemical compounds

The Bark has lupeol, saponins, tannins, gums and 4,5,7- trihydroxyflavone-3-O-β-D-glucopyranosyl (1-4)-α-L-rhamnopyranoside, nhexacosanol and palmitic acid isolated from seeds, lactone isolated from root bark, polysaccharide isolated from flowers-had a continuous

backbone of 4(1-4)- β -linked D-galactopyranose and 2 (1-3)- β -linked Larabinopyranose units with β -linked D-galactose and α -linked L rhamnose and L-arabinose units as end groups [8]. Leaves contain a flavonol C-glycoside shamimin [9]. Hemigossypol-6-methyl ether was isolated from the root bark of *B. malabaricum* along with isohemigossypol-1-methyl ether [10]. From *Bombax ceiba* stem bark a Shamimicin, (3, 4- dihydroxyphenyl)-3, 4- dihydro-3, 7- dihydroxy-5-O - xylopyranosyloxy- 2H-1-benzopyran along with lupeol were isolated [11]. From the dried leaves of *B. malabaricum* in the same year, mangiferin, a xanthone was separated by repeated column chromatography of the n- BuOH fraction [12]. From the root bark of *B. malabaricum*, new sesquiterpene lactone, 5-isopropyl-3-methyl-2, 4, 7-trimethoxy-8, 1- naphthalene carbolactone together with naphthoquinone, 8- formyl -7-hydroxy - 5- isopropyl - 2- methoxy 3 methyl 1, 4-naphthoquinone were isolated [13]. Phytochemical investigation of *Bombax malabaricum* shows the presence of five new compounds (bombamalones A-D, 1-4; bombamaloside, 5), and four known compounds (isohemigossypol-1-methyl ester, 6; 2-Omethylisohemigossylic acid lactone, 7; bombaxquinone B, 8; and lacinilene C, 9) [14]. A new naphthoquinone together with 7 hydroxycadalene and 8-formyl-7-hydroxy-5-isopropyl-2-methoxy-3-methyl-1, 4-naphthoquinone were isolated from the heartwood of *Bombax malabaricum*. The new naphthoquinone was characterized as 7-hydroxy-5-isopropyl-2-methoxy-3-methyl-1, 4-naphthoquinone based on spectral and chemical studies [15].

3. Bioactivities

3.1 Anti-inflammatory activity

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 (16).

3.2 Hypotensive activity

Shamimin along with lupeol [lup-20 (29) en-3 β -ol], which possesses potent hypotensive activity, have been isolated from *B. ceiba* stem bark. BCBMM [filtrate from BCBM (Methanolic extract of defatted stem bark)] one of the most active fractions has revealed its adverse effects on heart, liver and kidneys of mice at the dose of 1000 mg/kg/d [17].

3.3 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. [18]. 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, but increase in the level of total protein in comparison to control. MEBC significantly decreased the level of TBARS (thiobarbituric acid reactive substances) and elevated the level of GSH (reduced glutathione) at all doses as compared to control. 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.[18].

3.4 Inhibitory effects on fatty acid syntheses

Fatty acid syntheses (FAS) had been found to be over express and hyperactive in most cancers. [19]. Pharmacological inhibitors of FAS activity preferentially repress cancer cell proliferation and induce cancer cell apoptosis without affecting nonmalignant fibroblasts. These made FAS an excellent drug target for cancer therapy. The FAS activity is the lowest in gastric cancer cell N87 (15.91 \pm 3.61 U/ mg protein) and the highest in lung cancer cell A549 (127.36 \pm 10.14 U/mg protein). The cancer cell A549 was used as a cell model to test the inhibitory effort of flavonoid extracts on FAS. The minimum inhibitory concentration of *B. ceiba* Linn was 247.98 μ g/ml.[20]

3.5 Antipyretic

The methanol extract of *Bombax malabaricum* (syn *Bombax ceiba*) leaves (MEBM) was investigated for the antipyretic activity in rats.[21] MEBM possessed significant antipyretic activity in Baker's yeast-induced pyrexia. Phytochemical tests showed the presence of steroids, carbohydrates, tannins, deoxy-sugars, flavonoids and coumarin glycosides (21).

3.6 Aphrodisiac

The aphrodisiac activity of *B. ceiba* root extract was investigated. The extract (400 mg/kg body wt/day) was administered orally by gavage for 28 days.[22] Mount latency (ML), intromission latency (IL), ejaculation latency (EL), mounting frequency (MF), intromission frequency (IF), ejaculation frequency (EF) and post-ejaculatory interval (PEI) were the parameters observed before and during the sexual behavior study at day 0, 7, 14, 21, and 28 days. The extract reduced significantly ML, IL, EL and PEI ($p < 0.05$). The extract also increased significantly MF, IF and EF($p < 0.05$). These effects were observed in sexually active and inactive male mice [22].

3.7 Antimicrobial and antibacterial activity

Plant extracts (methanol and aqueous) were assayed for their activity against multi-drug resistant *Salmonella typhi*. Strong antibacterial activity was shown by the methanol extracts of *Salmalia malabarica*. [23]. Plant or plant parts were collected, dried, homogenized and extracted in two organic solvents viz. methanol and acetone. The antibacterial activity against *Klebsiella pneumoniae* was done by agar disc diffusion method. The activity was compared with standard antimicrobials Amikacin and Piperacillin.[24].

3.8 Cytotoxicity

Aqueous extracts of the plants were screened for their cytotoxicity using the brine shrimp lethality test.[25] 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 [25].

3.9 Antioxidant activity

The antioxidant activity of a methanolic extract of *B. ceiba* was evaluated using several antioxidant assays, in terms of its: (i) ability to scavenge DPPH (1, 1-diphenyl-2-picryl-hydrazyl) and hydroxyl free radicals; (ii) action against lipid peroxidation (in rat liver microsomes and soy bean phosphatidylcholine liposomes), induced by ascorbyl radicals and peroxyxynitrite; and (iii) effect on myeloperoxidase activity. [26] The cytotoxicity was monitored through the mitochondrial activity in the Vero cell line. The extract showed antioxidant activity in all assays. The EC (50) for DPPH was 87 µg/ml; lipid peroxidation of microsomes and soy bean liposomes induced by ascorbyl radicals were 141 µg/ml and 105 µg/ml, respectively, and by peroxyxynitrite were 115 µg/ml and 77 µg/ml, respectively. The K (0.5) value for myeloperoxidase activity inhibition by the extract was 264 µg/ml. The extract showed very low toxicity toward Vero cells.[26]. The total phenolic content present in water extracts of *B. ceiba* (ela imbul; gum), was determined by Folin-Ciocalteumethod. Caffeine and gallic acid were quantified by highperformance liquids chromatography (HPLC). Total freeradical scavenging activity of each ingredient was investigated by 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging method and the values were compared with phenolic andgallic acid present in each plant. The polyphenol contentof *B. ceiba* were $32.57 \pm 5.04\%$ of total extractable. Detectable levels of gallic acid were present only in *B. ceiba* (1.46 mg/g of total extractable). The EC₅₀ values for DPPH radicalscavenging activity for *B. ceiba* were $15.47 \pm 1.80 \mu\text{g cm}^{-3}$, The mean values of EC₅₀ (y) for DPPH radical scavenging activity were correlated with total phenolics (x) present in plant extracts ($y = -35.417x + 1428$; $R = 0.9887$)[27].

4. Conclusion

B. ceiba has a long history of traditional use for a wide range of diseases. It is an important species that has economic and ecological importance and should be conserved for ecological perspectives. The plant is used in dysentery, menorrhagia, skin troubles, haemorrhoids, for the treatment of snake bite and scorpion sting, boils, leucorrhoea, internal bleeding, calculus affections, chronic inflammation, ulceration of bladder and kidney, gonorrhoea, haemoptysis, influenza, enteritis, pulmonary tuberculosis, cystitis and catarrhal affections bleeding piles and has many bioactivities and interesting bioactive chemical compounds.

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