Novel Approaches in Drug Designing & Development
ISSN: 2575-8942

Juniper Publishers
key to the Researchers

Mini Review
Volume 6 Issue 4 - March 2023
DOI: 10.19080/NAPDD.2023.06.555695

Nov Appro Drug Des Dev

Various Therapeutics Activities of *B. Ceiba*: An Overview

Neetu[1]*, S. Ramasamy[2], Sobhna Singh[2], Vinod Kumar Singh[3] and Mohammad Ahmad[4]

[1]*Research Scholar, Department of Pharmacy, MJP Rohilkhand University, Bareilly, India*

[2]*Faculty, Department of Pharmacy, MJP Rohilkhand University, Bareilly, India*

[3]*Research Scholar, Department of Pharmacy, Integral University, Lucknow, India*

[4]*Assistant Professor, Department of Pharmacy, Integral University, Lucknow, India*

Submission: February 11, 2023; **Published:** March 14, 2023

***Corresponding author:** Neetu, Research Scholar, Department of Pharmacy, MJP Rohilkhand University, Bareilly, India

Abstract

In comparison to conventional medications, herbal plants have several advantages, including the fact that they often cause less adverse effects and, with prolonged usage, may even be non-toxic. They are more widely available and less priced. This review consists of an extensive survey of literature from the Scopus/PubMed, Google Scholar, and other international reputed sources. This review was based on study of phytochemistry and pharmacological activities of *B. ceiba. B. Ceiba* is an enormous, stunning, and deciduous tree and native for Northern Australian origin. It is extensively dispersed in Africa, Australia, and Asia. Plants can be found climbing hills up to 1,500 metres in India's drier regions. The plant has wide, spreading branches and young stems that are covered in thick, stiff prickles. It can grow to a height of 25 to 30 metres. The bark ranges in colour from silver grey to ash and is between 1.8 and 2.5 cm thick. Large, palmate, glabrous leaves have 3–7 entire, lanceolate leaflets and measure 13–15 cm long by 7–10 cm wide. Plants develop in the sweltering regions of India, climbing the hills up to 1,500 m. It was determined for Isohemigossylic acid lactone–2–methyl ether, lupeol, shamimicin and Mangiferin etc. Analgesic, anthelmintic, anticancer, antibacterial, anti-diabetic, anti-inflammatory, hepatoprotective, immunomodulatory, cardioprotective, antiulcer, anti-diarrheal, antiviral, and hypotensive properties were all assessed for the plant *B. ceiba*. In conclusion, through experimental pharmacology, most of the medicinal claims made for the plants in the various traditional remedies have been verified.

Keywords: Bombax Ceiba; Phytochemistry; Pharmacological Activities; Anti-Cancer; Review; *B. Ceiba*; Herbal Plants; Hepatic Injury

Abbreviations: MEBC: Methanolic Extract of *B. Ceiba* Flowers; INH: Isoniazid; RIF: Rifampicin; ALP: Alkaline Phosphatase; ALT: Alanine Transaminases; AST: Aspartate Transaminases; TBARS: Thiobarbituric Acid Reactive Substances; GSH: Glutathione

Introduction

In comparison to conventional medications, herbal plants have several advantages, including the fact that they often cause less adverse effects and, with prolonged usage, may even be non-toxic. They are more widely available and less priced [1]. There is a lot of potential for using plants to treat and control diseases. Many nations' traditional and tribal healers have used a wide range of plants to treat a wide range of illnesses [2]. Biologically active phytochemical components are necessary for plants to function therapeutically. In addition to their traditional usage as organoleptic enhancers in food preparation, spices are also commonly used in veterinary health care. There is considerable research being done on the therapeutic qualities of several herbs and spices [3]. Because they contain active ingredients that have a biological impact on human health, plants provide therapeutic benefits. Flavonoids, alkaloids, terpenoids, steroids, tannins, glycosides, steroids, carotenoids, and other phenolic compounds are examples of phytochemicals found in plants that have specific uses in herbal medicine [4]. Herbs and spices have been used in a wide range of ways throughout history. Since the beginning of time, people have utilised spices and edible herbs to enhance the flavour and organoleptic properties of food. Different spices and herbs have historically been employed in both medical and food preservation [5].

Plant Description

B. Ceiba is an enormous, stunning, and deciduous tree and native for Northern Australian origin. It is extensively dispersed in Africa, Australia, and Asia. Plants develop in the sweltering regions of India, climbing the hills up to 1,500 m. Plants can be found climbing hills up to 1,500 meters in India's drier regions. The plant has wide, spreading branches and young stems that are covered in thick, stiff prickles. It can grow to a height of 25 to 30 metres. The bark ranges in color from silver grey to ash and is between 1.8 and 2.5 cm thick. Large, palmate, glabrous leaves have 3–7 entire, lanceolate leaflets and measure 13–15 cm long by 7–10 cm wide.

Normally, the leaves disappear over the winter and come back during the flowering season. Flowers are enormous in diameter, scarlet in colour, and loaded with nectar. The fruits can grow up to 15 mm long, are brown in colour, and resemble capsules. They are filled with numerous obovoid, black, amorphous seeds. White hairs cover the smooth seeds. Market names for the bark-derived gummy exudate include "Semul gum," "Mocharasa," and "Suparika phulaa" [6] (Figure 1 a-c).

Figure 1(a): Leaves.

Figure 1(b): Flower.

Figure 1(c): Stem.

Figure 1: Depiction of various parts of *B. ceiba*.

Taxonomy

Division - Magnioliophyta

Class - Magniolipsid

Order - Malvales

Family - *Bombacaceae*

Genus - *Bombax*

Species – ceiba

Distribution

Bombax ceiba Linnaeus belongs to the family *Bombacaceae* which has roughly 26 genera and nearly 140 pantropical species.

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It is commonly \known as Semal, Simbal, Simul, Indian kapok, Katsavar, Indian *bombax**Red Silk* cotton tree. It is extensively found in temperate Asia, Tropical Asia\Africa and Australia. In India, it can be found at altitudes up to 1500 m. In peninsular India, the tree is highly prevalent in the dry as well as moist \deciduous forests and near rivers. The tree is a strong light-demander\sand quick growth. It grows well on deep sandy loams or other well drained soils, particularly in valleys, in places receiving 50 to 460 cm\annual rainfall well dispersed throughout the year [7].

Chemical Constituents

The chemical constituents were observed in different parts of the *B. ceiba* plant as below-

Root bark: It was determined for Isohemigossylic acid lactone–2–methyl ether, lupeol, shamimicin and Mangiferin etc [8].

Flowers: These include -sitosterol, -sitosteril—D-glucoside, -polysachharide—D-galactose, -hentriacontane, -hantriacontanol, -quercetin, -kaempferol, -L-arabinose, -L-rhamnose [9].

Leaves: The presence of crude protein, crude fibre, calcium, phosphorus, shamimin, and mgniferin has been documented in leaves [10].

Seeds: N-hexacosanol, palmitic acid, octadecyl palmitate, gallic acid, tannic acid, 1-gallayl-glucose, ethyl gallate, and a combination of alpha, beta, and gamma tocopherols are all present in seeds [11,12] (Figure 2a-d).

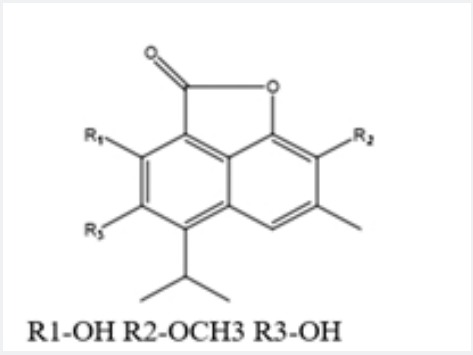

Figure 2(a): Isohemigossylic acid lactone–2–methyl ether.

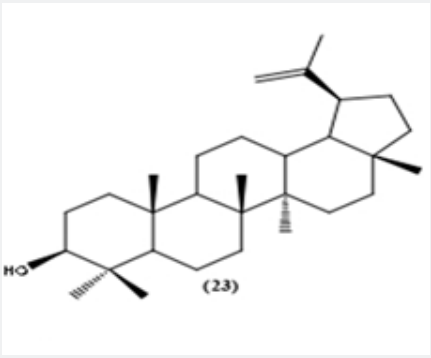

Figure 2(b): Lupeol.

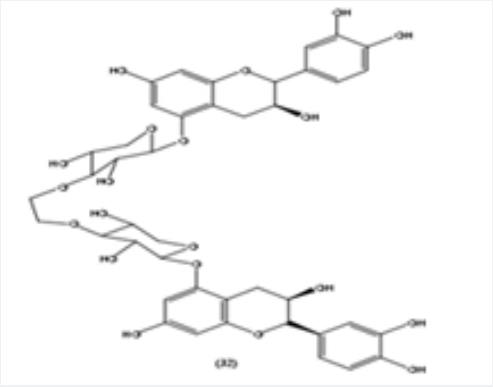

Figure 2(c): Shamimicin.

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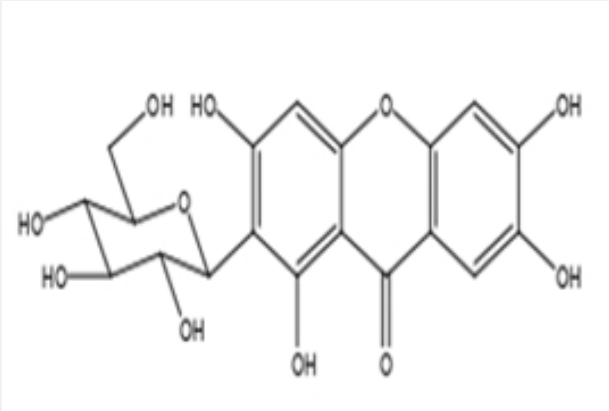

Figure 2(d): Mangiferin.

Figure 2: Structure of some chemical constituents.

Pharmacological properties

Anti-H. Pylori: Bombax malabaricum ethanolic extract was found to have potent anti-helicobacter pylori action. The ethanolic extract's lowest inhibitory concentration ranged from 0.64 to 10.24 mg/ml [14].

Anti-nociceptive and anti-inflammatory: In experiments on mice using acetic acid to produce writhing and a hot plate, ethnolic crude extract of leaves (BCL, 10, 50, 100 mg/kg), isolated mangiferin (42.2 mg/kg, s.c.), and mangiferin devoid fraction (BCM, 10, 50, 100 mg/kg) all exhibit notable analgesic effect. It has been shown that the reactions to acetic acid-induced pain are dose dependents. Mangiferin and morphine (0.25 mg/kg s. c.) both exhibit 65% and 70% suppression of pain caused by acetic acid, respectively. Naloxone (5 mg/kg), a non-selective opioid antagonist, however, caused the equivalent effects to drop to 19% and 28%. As a result, it suggests that mangiferin works through the same opioid pathway as morphine to relieve pain. BCL, BCM, or mangiferin exhibit a central analgesic effect in the hot plate model after 90 minutes. While mangiferin exhibits strong interaction with these receptors at the peripheral with a small contribution at the central level, the effect of extract was reported to be independent of opioid receptors when naloxone was used to measure its effects. The methanolic extract of flowers (250 and 500 mg/kg) also demonstrated peripheral and central analgesic efficacy [15]. In cases of carrageenan-induced paw edoema and CCl4-induced hepatotoxicity in rats, Bombax ceiba's bark, xylem of the stem, and roots were found to be protective.

Angiogenesis: At concentrations of 50 and 30 g/mL, the active ingredient lupeol, which was extracted from a methanolic extract of the stem bark, strongly prevented the development of human umbilical venous endothelial cells into tubes. However, in studies using particular cell-lines, including SK-MEL-2, A549, and B16-F10 melanoma, lupeol did not demonstrate any influence on the proliferation of tumour cells [16].

Anticancer: A number of cancer cells, including hepatoma (HepG2), esophageal carcinoma (EC109, EC8712, H5E973), uterine cervix cancer (HeLa), lung carcinoma (A549, 95-D), gastric carcinoma (N87, BGC823), and leukaemia, were screened for their effects on fatty acid synthase (FAS) in the presence of flavonoid-rich *B. ceiba* (K562, U937). It has been noted that the enzyme is overexpressed and hyperactive in several malignancies. The enzyme is highly inhibited by the extract in several cancer cells. The FAS activity is highest in lung cancer cell A549. It is lowest in gastric cancer cell N87. To further illustrate the extract's inhibitory action on FAS, the cancer cell A549 was employed. *B. ceiba* had a minimum inhibitory concentration of 247.98g/ml [17].

Antibacterial: Additionally effective against E. coli, P. aeruginosa, and S. aureus was the *B. ceiba* seed extract. Different seed extracts were tested for their ability to inhibit the growth of Aspergillus fumigatus, E. coli, B. subtilis, S. aureus, Enterococcus faecalis, and Alcaligenes faecalis, as well as C. albicans, Aspergillus niger, Aspergillus flaves, and chloroform. Significant antibacterial activity was found in acetone and methanol extracts (200g/ml), particularly against C. albicans, E. coli, B. subtilis, E. faecalis, and A. faecalis [18].

Antidiabetic: This hydro-methanolic extract's n-hexane fraction (0.1 gm/kg) has sizable hypoglycemic and hypolipidemic effects as well. In addition, n-hexane fraction raises serum insulin levels, boosts haemoglobin levels, and lowers glycated haemoglobin. Additionally, the fraction was said to be beneficial in preventing the Langerhans islet cells in diabetic mice [21]. At 100 M concentrations, several *B. ceiba* compounds, such as quercetin 7-O-D-glucopyranoside and epicatechin-3-O-bxylopyranoside, effectively inhibit the -glucosidase enzyme (by 50.5% and 48.3%, respectively) [19].

Diuretic: At dose levels of 200 and 400 mg/kg, the aqueous and ethanol extracts of the *B. ceiba* fruit have a slow-onset (within 5 h) diuretic activity that lasts for up to 24 hours. Both extracts significantly increase the amount of urine produced in rats who are dehydrated. Aqueous extract's (400 mg/kg) 5-hour activity was comparable to that of the reference medication frusemide. Increased excretion of electrolytes (Na+, K+, and Cl-) is another

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side effect of the aqueous extract, however urinary pH and specific gravity are not significantly affected [20].

Immunomodulatory: By examining its impact on Hemagglutinating Antibody (HA) Titer, Delayed Type of Hypersensitivity (DTH) Response, Hematological Profile (Hb, WBC, RBC), Oxidative Markers, and Cytokine, Methanol Extract of the Bark of *B. Ceiba* Shows Significant Immunomodulatory Action in Normal and Cyclophosphamide-Induced Immunosuppressed Mice Models [21].

Anti-hypertensive: *B. ceiba* stem bark has been the source of shamimin and lupeol [lup-20 (29) en-3b-ol], both of which have been shown to have powerful hypotensive activity. One of the most active fractions, BCBMM [filtrate from BCBM (Methanolic extract of defatted stem bark)], has been shown to have toxic effects on the heart, liver, and kidneys of mice when given at a level of 1000 mg/kg/d [22].

Antioxidant: Multiple antioxidant assays were used to assess the antioxidant activity of a methanolic extract of *B. ceiba*, including I its ability to scavenge DPPH (1, 1-diphenyl-2-picrylhydrazyl) and hydroxyl free radicals; (ii) its action against lipid peroxidation (in rat liver microsomes and soybean phosphatidylcholine liposomes), induced by ascorbyl radicals Vero cell line mitochondrial activity was used to measure cytotoxicity. All tests performed on the extract demonstrated its antioxidant properties. Lipid peroxidation of microsomes and soybean liposomes was produced at concentrations of 141 and 105 micrograms per millilitre (g/ml), respectively, by ascorbyl radicals, and at concentrations of 115 and 77 micrograms per millilitre (g/ml) by peroxynitrite. Myeloperoxidase activity was inhibited at a concentration of 264 ng/ml, which is the K (0.5) value for the extract. The extract was shown to be non-toxic to Vero cells [23].

Hepatoprotective: Methanolic extract of *B. ceiba* flowers (MEBC) was tested for its hepatoprotective properties against the toxicity of the anti-tubercular medication combination of isoniazid (INH) and rifampicin (RIF) in rats during the course of 10 and 21 days of intraperitoneal administration. Three different doses of MEBC (150, 300, and 450 mg/kg i.p. 45 min before the anti-tubercular challenge) were given to the animals. The challenges occurred 10 and 21 days later. Alkaline phosphatase (ALP), alanine transaminases (ALT), aspartate transaminases (AST), and total bilirubin levels were all significantly lower in patients with MEBC, but total protein levels were higher. When compared to the control group, the concentration of thiobarbituric acid reactive substances (TBARS) was considerably reduced by MEBC across all doses, while the concentration of reduced glutathione (GSH) was increased. After looking at biochemical markers and histological examinations, researchers came to the conclusion that MEBC could not entirely reverse the hepatic injury caused by INH and RIF, but they could mitigate the drugs' effects to the point where necrosis did not occur [24].

Fatty acid synthesis inhibition: Studies have shown that most malignancies have abnormally high levels of FAS expression and activity. Drugs that limit FAS activity have been shown to have a selective effect on cancer cells, killing off the malignant ones while leaving the healthy fibroblasts alone. Due to these characteristics, FAS has shown to be a highly desirable therapeutic target for cancer treatment. N87 gastric cancer cells have the lowest FAS activity (15.91 3.61 U/mg protein), whereas A549 lung cancer cells have the highest (127.36 10.14 U/mg protein). To determine the efficacy of flavonoid extracts in inhibiting FAS, they were tested on the cancer cell line A549. For *B. ceiba* Linn, the MIC was determined to be 247.98 g/ml [25].

Antipyretic: The antipyretic efficacy of a methanol extract of Bombax malabaricum (syn. Bombax ceiba) leaves (MEBM) was studied in rats. In a model of hyperthermia caused by Baker's yeast, 52 MEBM showed considerable antipyretic efficacy. Steroids, carbohydrates, tannins, triterpenoids, deoxy-sugars, flavonoids, and coumarin glycosides were all detected by phytochemical analysis [26].

Aphrodisiac: Traditional medicine in the Indian subcontinent calls for the young roots of *B. ceiba*, also known as Semal-musli, to stimulate sexual desire. Its juice has been hailed for its purported health benefits and sexual arousal properties. Root aqueous extract lyophilization influences sexual behavior, spermatogenesis, and anabolic effects in male albino rats in the presence of female rats. There was a marked increase in mount, intromission, and ejaculation frequency, and there was also a noticeable increase in body weight. Improvements were seen in both the amount of fructose in the seminal fluid and the number of sperm in the epididymis [27].

Anti-acne: The Salamalia malabarica Schott. and Endl thorn has been used to cure facial acne. Leaf's MIC value of 500 g/ml was superior to the normal clindamycin's MIC of 250 g/ml, while the alcoholic extract of bark and thorns shown very high anti-acne capability against Propionibacterium acne. The granulomatous inflammation caused by P. acnes in rats was mitigated by all three extracts. Himalaya's "Acne-N-Pimple Cream" is a polyherbal formulation suggested for the management of acne vulgaris, and it contains thorns of S. malabarica as one of its key ingredients. When compared to a placebo, cream significantly reduced the number of blackheads, whiteheads, pustules, and overall inflammation. As a treatment for acne vulgaris, "Acne-N-Pimple Cream" has been shown to be both effective and safe in clinical trials [28].

Cardioprotective: Powder made from the roots of the *B. ceiba* plant drastically alters coronary risk markers like atherogenic lipids, fibrinogen, and oxidative stress in individuals with ischemic heart disease. High levels of phenolics and tannins, which contribute to its antioxidant action, have also been reported [29].

Conclusion

The phytochemistry and pharmacological qualities of *B. ceiba*, which is extensively employed in the Indian system of medicine known as Ayurveda, have been the subject of the current review. Every component of *B. ceiba*, including the leaves, bark, roots, flowers, and gum, is utilised in the treatment of many ail-

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ments. Today, there is a need for analysis of the active substances responsible for various pharmacological principles. Mangiferin, quercetin, shamimin, shamimoside, -sitosterol, taraxeryl acetate, lupeol, simalin a, simalin b, shamimicin, bombamalones a-d, bombaxquinone b, bombamaloside, and bombasin are only a few of the phytoconstituents from the Analgesic, anthelmintic, anticancer, antibacterial, anti-diabetic, anti-inflammatory, hepatoprotective, immunomodulatory, cardioprotective, antiulcer, anti-diarrheal, antiviral, and hypotensive properties were all assessed for the plant *B. ceiba*. Through experimental pharmacology, most of the medicinal claims made for the plants in the various traditional remedies have been verified.

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