Pharmacognosy, Phytochemistry & Pharmacological activities of Butea monosperma

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***Abstract*- The primary goal of this review is to gather knowledge about *Butea monosperma.* The review information made available by this research is useful for expanding the possible use of *Butea monosperma,* which may contribute a substantial lead molecule.**

***Key words- Butea monosperma, Leguminosae,* Polyphenols,Terpenes & Flavonoids.**

Introduction:

BM(*BUTEA MONOSPERMA*), sometimes known as the flame tree, belongs to the subfamily Caesalpinioideae of the family Fabaceae (previously Leguminosae). In India, the plant is known as the Palash tree. It is found throughout India and the South Asian peninsula [1]. It is a deciduous tree of medium size. It can reach a height of 10-15 meters. Because of the greater branching, it appears to be a little shrub when it grows to a height of 1-2 meters. Its bloom is odorless and appears scarlet throughout the spring blossoming season, and its leaves are trifoliate. The plant has several Pharmacological activities such as appetizer, laxative, anthelmintic, and aphrodisiac, among others. Plant parts such as flower, gum, seed, leaf, and bark1 [2-9] may be used. According to Ayurveda, *BM*can also help to balance Kapha and Vata [10]. Butein, butrin, flavonoid and steroids (flower), glucose, glycosides (roots), tannin (gum), oil, proteinase and polypeptidase (seed), and other active ingredients are found in various regions of *BUTEA MONOSPERMA*. The current article discusses the phytochemical and pharmacological activities of several sections of the *BUTEA MONOSPERMA*.

BM(monosperma):

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Taxonomic classification

Kingdom:Plantae
Domin:Eukaryote
Phylum:Tracheophyta
Family:Fadateae
Sub-family:Fadoidvae
Order:Fabales
Genus:Butea
Species: B. Monosperma
Class:Dicotyledons

Geographical Source:

*BM*is a species of Butea native to tropical and sub-tropical parts of South Asia and Southest Asia,ranging across Bangladesh, India, Nepal, Pakistan, Sri Lanka, Myanmar, Thailand, Laoas, Cambodia, Vietnam, Malaysia, and western Indonesia.

Ayurvedic context of Butea monosperma

As a medicinal plant used in Ayurvedic medicine, *BM* has a significant impact. The particular epithet monosperma means "one seeded" and refers to the fruit of the Fabaceae family containing a single seed towards its apex [11]. Palash was the name given to *BM* after an extensive analysis of Ayurveda. Charaka Samhita, Susruta Samhita, Astanga Sangraha, Astanga Hrdaya Vedas, and Upanisads all describe it in detail. The plant is defined in Mahakasaya [12] of the Charaka Samhita. Palash is classified as Ambasthadi, Nyagrodhadi, Muskakadi, and Rodhradi in the Susruta Samhita. Palash is also mentioned in Ambasthadi, Muskakadi, Nyagrodhadi Gana, and Rodhradi in Astanga Hrdaya and Susruta Samhita. Vagbhata mentioned Palash in Asanadi,

Rodhradi, Muskakadi, Ambasthadi, and Nyagrodhadi Gana in Astanga Sangraha.. Palash is also described in depth in the Samhitas Harita, Bhela, Sharangadhar, and Kasyapa. Cikitsagranthas refer to it as Gadanigraha, Bhaishajya Ratnavali, Bhavaprakasha Samhita, and Cakradutta. The goodness of Palash has been defined by Nighantus in many diseases, for example, the rasa of Palash is useful in kasaya and tikta. The fruit section of the *BUTEA MONOSPERMA*, according to Bhavaprakash Nighantu, is relevant in the Krimi, Arsa, and Vatakaphaja rogas.

Morphalogical characters and phytochemistry

Flower:

Colour: Bright orange red , rarely yellow.
Odour: Odour less.
Shape: Usually branch lets, wings and keel recurved
Size: 5 to 40 centimeter long , 4 short lobes,corolla 5 to 7 centi meter long

Chemical Consituents:

It contains triterpene butrin, isobutrin, coreopsin, sulphurein, isocoreopsin, monospermoside and chalcones, isomonospermoside, aurones, steroids and flavonoids. Glycoside of the *BM*contains 5,7-dihydroxy -3,6,4-trimethoxy flavone-7ss-O-α-L xylopyranosyl (1→3)-O-α-L-arabinopyranosyl-(1→4)-O-β-D galacto pyranoside [14,15].

Gum:

Gum contains mucilaginous material, pyrocatechin and tannins [16].

Seeds:

Colour: Brown
Shape and size: Seed ellipsoid, flattened, about 3 cm long.

Chemical constituents: :

Oil contains polypeptidase, lypolytic enzymes, proteinase and proteolytic [16]. Palasonin and nitrogenous acidic compounds is present in seeds. Seed also contains isomonospermoside, monospermoside and allophanic acid. Flavone glycoside present in the seeds of *BM*which possess potential antiviral activity [17]. *BM*seeds contain fixed oil, mixed fatty acids, and unsaponifiable matter [18].

Resin:

Resin contains jalaric esters I, II and laccijalaric esters III, IV α amyrin, β-sitosterone its glucoside and sucrose; lactone-nheneicosanoic acid-δ-lactone [19].

Saponin:

Saponin contains butein, butin, butrin, colourless isomeric flavanone and chalcones [20].

Leaves:

Colour: Drak gree
Shape and size: Leaves trifoliate; petiole 7.5-20 cm long with small stipules; leaflets more or less leathery, lateral ones obliquely ovate, terminal one rhomboid- obovate, 12-27 x 10-26 cm, obtuse, rounded or emarginate at apex, rounded to cuneate at base, with 7-8 pairs of lateral veins, stipellate.
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Chemical constituents:

Leaves contain kino-oil containing oleic, linoleic acid, lignoceric acid and palmitic [21].

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Bark:

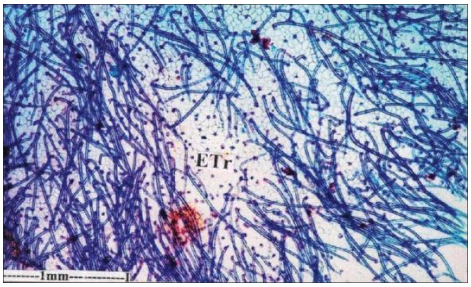
Colour: Geayish Brown
Size: 5 to 15 meters tall, upto 43 centimeter dbh.

Chemical consituents:

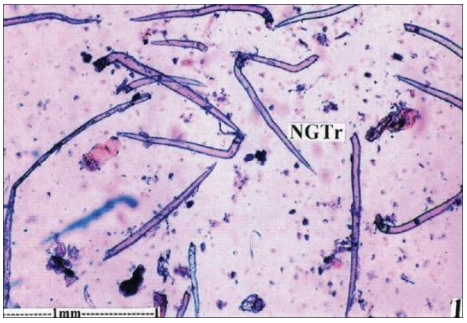
Barks contain gallic acid, kino-tannic acid, pyrocatechin. Barks also contain allophanic acid, butolic acid, shellolic acid, butrin, alanind, palasitrin, cyanidin, histidine, palasimide and miroestrol [21,22]. Isolation from stem bark methanolic extract of *BM*gives two structurally related methoxyisoflavones; cajanin and isoformononetin [23]. The phytochemical investigation and isolation of the stem bark of *BM*contain following compounds such as buteaspermin A, buteaspermin B and buteasperminol, medicarpin, cajanin, formonentin, isoformonentin and cladrin [24]. The active constituent obtained from ethyl acetate and petroleum extracts of the stem bark of *BM*was medicarpin [25].

MICROSCOPY OF BUTEA MONOSPREMA

Epidermal trichomes

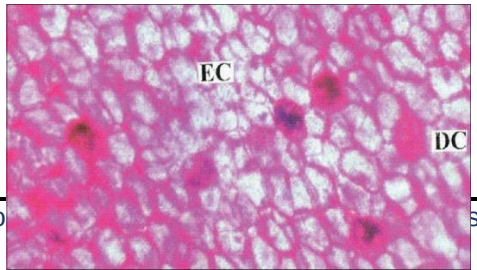


multicellular appendages that grow from above-ground epidermal cells in plants. These appendages serve an important function in plant development and are seen in a wide range of species.

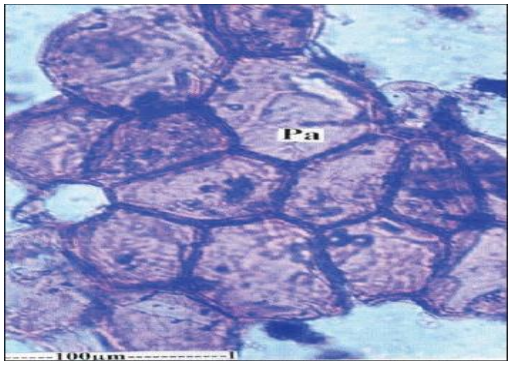


Nonglandular tricomes:

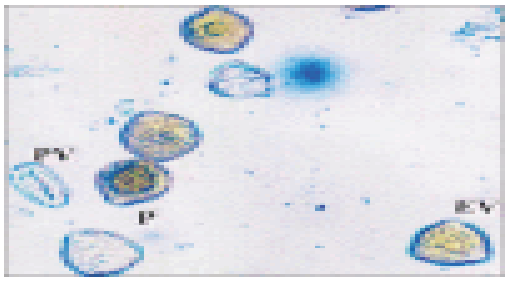
Second type of trichomes which are short and unicellular



Epidermal cells:
An outer thick pectinaceous layer with a few cellulose microfibrils and an inner mainly cellulosic layer.



Parenchyma cells:
Parenchyma is integral to vascular tissue, where it provides a route of exchange for materials within and between the xylem and the phloem.



Pollen grains:
The interior section of pollen grain contains cytoplasm along with the tube cell, which converts into a pollen tube and the generative cell releases the sperm nuclei.

Phyto constituents of Butea monosperma

Flowers- [a] Triterpene : butrin, isobutrin, coreopsin, sulphurein, isocoreopsin, monospermoside, chal- cones, isomonospermoside, steroids.
[b] Glycoside : -5,7-dihydroxy -3,6,4-trimethoxy flavone-7-O-α-L xylopyranosyl (1→3)-O-α-L- arabinopyranosyl-(1→4)-O-β-D galacto pyranoside.
Gum : Tannins : Mucilaginous material, pyrocatechin
Seed : Enzymes: Polypeptidase, lipolytic enzymes, proteinase and proteolytic enzymes
Resin :Esters : Jalaric esters I, II and laccijalaric esters III, IV α amyrin.
Saponin : polyphenols : Chalcones, butein, butin
Leaves : Fatty acid: Kino-oil containing oleic, linoleic acid, lignoceric acid.
Bark :Amino acids : Allophanic acid, butolic acid, shellolic acid, butrin, alanind, palasitrin, cyanidin, histidine
Stem :Steroids : Stigmasterol-β-D-glucopyranoside and nonacosanoic acid

Pharmacological Activities:
Anti-filarial:
Aqueous extract of *BM* effectively decreased the motility of microfilariae (Brugia malayi). This impact was dosage dependant, with an IC50 value of 83ng/ml [26].
Anti-Diabetes:
Alloxan was used to cause diabetes in male rats. An ethanolic extract of *BM* leaves administered orally shown anti-diabetic effects. *BM* extract dramatically lowers blood glucose levels and increases antioxidant enzyme activities after 45 days of continuous therapy at 300mg/kg dosage, implying that *BM* leaves have strong antioxidant and hypoglycemic effects [27,28].
Anti-inflammatory and anti-oxidant activities:
Various extracts of *BM* leaves demonstrated anti-inflammatory activity in human red blood cells (HRBC) membrane stabilizing technique. The petroleum ether and chloroform extracts were significantly anti-inflammatory, but the hexane, ethyl acetate, and ethanol extracts were somewhat antioxidant and anti-inflammatory [29,30].

Flower:
Anticancer:
An aqueous extract of *BM* demonstrated anticancer activity by accumulating cells in the G1 phase and limiting cell proliferation

with considerable activation of apoptotic cell death, implying that *BM*possesses anticancer qualities [31].

Anticonvulsant:
A petroleum ether extract of *BM*was column chromatographically fractionated with varied polarities such as ethyl acetate, n-hexane, and methanol. The fractionated petroleum extract of *BM*demonstrated anticonvulsant efficacy against seizures induced by maximal electroshock (MES), Pentylenetetrazole (PTZ), and lithiumsulfate-pilocarpine nitrate. Furthermore, triterpenes found in *BM*have antidepressant properties [32].

Antihyperglycemic Activity
A 50% ethanolic extract of *BM*flowers significantly prevents hyperglycemia in wistar rats that has been caused by alloxan. The potential ethanolic extract of *BUTEA MONOSPERMA*, which has antihyperglycemic and antioxidant properties, demonstrated antidiabetic activity by lowering levels of total cholesterol, triglycerides, and very low-density lipoprotein cholesterol [33].

Antioxidant potential:
An ethanolic extract of *BM*reversed the oxidative damage that diabetic mice's numerous organs, including the pancreas, liver, and kidneys, demonstrated by a notable increase in thiobarbituric acid level and a clear decrease in glutathione content. The inclusion of flavonoids, saponins, and sterols in *BM*may be responsible for its anti-diabetic and antioxidant properties [34].

Antioxidant & Anti inflammatory :
Antioxidant and anti-inflammatory actions The anti-inflammatory effects of the *BM*methanolic extract (600 mg/kg and 800 mg/kg) were dose-dependent. It prevented the paw edema and granuloma in the rat model of paw edema and granuloma caused by carrageenan [35]. This might be because *BM*contains a variety of polyphenols, including butrin, isobutrin
, isocoreopsin, and butein [36].

Anti mycobacterial Activity :
Bioactive flavonoids found in *BM*flowers, including dihydromonospermoside, dihydrochalcone, monospermoside, isoliquiritigenin, and butein, have been shown to have antimycobacterial activity [37]. Its antifungal effect against different was found by the investigation.
Anti microbial activity :
The 5,7-dihydroxy-3,6,4-trimethoxy flavone has antimicrobial properties.7,O,L xylopyranosyl (1,3),O,L arabinopyranosyl (1,4)Galactopyranoside-O-D exhibited antibacterial properties. The antibacterial property of *BM*seed oil is against harmful bacteria and fungus. The oil is therefore fungicidal and bactericidal [39].

Antidopaminergic activity:
A methanolic extract of *BM*containing isoflavones demonstrated antidopaminergic activity, inhibited foot shock-induced aggressiveness in rats, and enhanced the catalepsy in a dose dependent manner [40].

Hepatoprotective effect :
The hepatoprotective effect of *BM*flower aqueous extract was investigated in comparison to CCl4 (1.5 ml/kg i.p.)-induced hepatotoxicity. Cirrhosis and necrosis of the liver can be brought on by CCl4. As a result, the treatment of CCl4 had a significant impact on several physiological variables, including levels of albumin, protein, hepatic lipid peroxidation, reduced glutathione, and total protein. It has been confirmed that *BM*has, in a dose-dependent manner, corrected all
changed biochemical parameters, including histological changes [41].

Free radical scavenging activity:
• Free radical scavenging effect: The 2,2 diphenyl-1-picrylhydrazyl (DPPH) radical, superoxide dismutase (SOD) assay, and the methanolic extract of the flower section of *BM*were used to evaluate the free radical scavenging effect. In addition, 2, 2' azo-bis (amid inopropane) dihydrochloride was used to assess the suppression of erthrocyte hemolysis. the activity may be due to the presence of polyphenols. [42].

Seeds:
Hormone balancing effect:
Alcoholic *BM*extract has anti-implantation and anti-estrogenic properties. However, active substances like butin, which also has male contraceptive qualities, are what cause the estrogenic
action. Additionally, *BM*seed methanolic extracts have uterine peroxidase activities and
antifertility effects [43].
Anti-implantation activity:
Butin is an active component of *BM*and has anti-implantation activity. At dosages of 5, 10, and20 mg/rat, oral treatment of Butin exhibited anti-implantation action. During pregnancy termination, a dose-dependent response was observed. Additionally, a reduction in the number of implantation sites was seen at lower doses. Butin lacks antiestrogenic activity but has estrogenic activity at comparable anticonception levels as seen in young female rats with ovariectomies [44].
Anthelmentic activity:
*BM*seeds' methanolic extract has a sizable amount of anthelmintic activity against Caenorhabditis elegans [45]. This discovery is

highly supported by the anthelmintic activity against Trichostrongylid nematodes in sheep. The crude powder made from *BM*seeds that was extracted with methanol (1, 2 and 3 mg/kg) had an anthelmintic action. Dependence on both time and dose was shown [46]. Additionally, the extract from the same solvent has strong anthelmintic action.

Anti-hyperlipidemic, anti-hyperglycemic, and anti-peroxidative effects:

The ethanolic extract made from *BM*seeds has these properties. In non-insulin dependent diabetic (NIDDM) rats, the ethanolic extract administered for four weeks showed a strong antihyperglycemic effect with better glucose tolerance [47].

Antiviral:

Isolated flavone glycoside from the seeds may have antiviral effects.

Antimicrobial activity :

Antimicrobial action was demonstrated by medicarpin present in seed oil [48].

Anti-inflammatory: The evaluation of antiinflammatory activity used the cotton pellet-induced granuloma and the carrageenin-induced paw oedema method. The study found that *BM*seed extract had potent anti-inflammatory effects when taken orally, which may be because the extract contains fixed oil, mixed fatty acids, and unsaponifiable materials [49].

Bark:

Anti-diarrhoeal: Castor oil-induced diarrhea and PGE2-induced enteropooling in rats may be prevented by consuming an ethanol extract of the bark and stem sections of *BUTEA MONOSPERMA*. Gastrointestinal motility was considerably decreased after oral administration of charcoal meal and *BM*extract [50].

Wound Healing activity :

Rats' wounds can be healed by *BM*bark ethanolic extract [51]. When applied topically to complete excision wounds formed on rats' backs, it sped up the healing process. At the wound infection site, the ethanolic extract of *BM*stimulated cellular proliferation and collagen formation. In an excision wound model, the extract accelerated wound contraction and sped up epithelialization while also boosting the area's hydroxyproline content, granulation tissue weight, and tensile strength [52].

Osteogenic and osteoprotective activity:

Cajanin, a compound isolated from the stem bark of *BUTEA MONOSPERMA*, has strong mitogenic and differentiation-promoting effects on osteoblasts. But it was discovered that isoformononetin has powerful anti-apoptotic and osteoblast differentiation-promoting properties [53]. The *BM*stem bark extract has osteogenic and osteoprotective properties [54].

Antiinflammatory activity:

The methanolic extract of the stem bark of *BM*showed analgesic and anti-inflammatory action against acetic acid induced writhing, hot plate test model and carrageenan induced paw edema in a dose dependent manner comparable to diclofenac sodium [55].

Anti-stress: Water soluble part of ethanolic extract of *BM*showed antistress effect. Ethanolic extract of *BM*decreases the elevated level of plasma corticosterone and brain serotonin and this anti-stress effect was comparable to that of diazepam [56].

Effects on hormone level:

Administration of Stigmasterol (2.6 mg/kg), isolated from the bark of methanolic extract of *BM*for 20 days in the experimental animals reduced serum triiodothyronine, thyroxin, and glucose concentrations with a concomitant increase in insulin. Moreover, there was significant increaseFollowing there was a significant increase in the levels of catalase, glutathione, and superoxidedismutase as well as a decrease in hepatic lipid peroxidation, indicating potential
thyroid inhibitory and hypoglycemic effects of stigmasterol [57].

Antifungal:

Medicarpin demonstrated more antifungal action against Cladosporium cladosporioides than the common fungicide Benlate [58].

Anti-ulcer:

A 500 mg/kg methanolic extract of *BM*bark demonstrated 79.30 and 82.20% healing against ethanol and aspirin-induced stomach ulcerations, respectively, indicating the extract's ability to scavenge free radicals and have an anti-ulcer action [59].

Fruits:

Hypoglycemic effect:

After therapy (3g/30ml of water for 30 days), *BM*methanolic extract significantly decreased blood urine sugar, plasma glycoprotein, and glucose levels. Additionally, a decrease in lipid profile and a restoration of liver enzyme activity point to potential anti-diabetic actions of *BM*fruit extract [60]. In both normal and alloxan-induced diabetic rats, the study found that herbal formulations made of three plant parts—Piper betel, Butea monosperma, and Trigonella foenum graecum—have anti-diabetic potential [61,62].

Antimicrobial and anti-fungal:

Numerous *BM*fractions have been found to have potent antibacterial properties against a wide range of bacterial and fungal species [63,64].

Antihelminthic effect:
Pippali rasayana with *BM* extract was used to test its immunostimulatory and antigiardia activity against Giardia lamblia, and nearly 98% of infected people recovered. In vitro research, however, demonstrated that Rasayana had no homicidal effect on the parasite despite the parasite's substantial activation of macrophages and elevated level of macrophage movement index. Phagocytic activity was also seen in *BM* extract (900 mg/kg). Furthermore, they gave the patients Pippali Rasayana orally in doses of 1g for a total of 15 days and observed that Giardia lamblia was completely absent from the patients.

Traditional Uses in Ayurveda
Sushruta Samhita, Charaka Samhita, and Ashtanga Hridaya, among other Ayurvedic texts, describe Palash as having numerous beneficial properties, making it a potent medicinal plant.

- These include anti-diarrheal, anthelmintic, anti-diabetic, anti-stress, hepatoprotective, antifungal, astringent, aphrodisiac, laxative, anti-inflammatory
- The tree's seeds act as a purgative and diuretic to increase urination.
- In the case of intestinal parasites, the seed powder is employed.
- The kino gum, produced from the bark of the palash tree, has astringent characteristics and is used to cure hemorrhoids.
- Has an inherent expectorant quality, meaning it can easily release any extra mucus or phlegm and eliminate it from the respiratory tract.
- When applied to sunburns and rashes, the extract from the leaves and blossoms calms the irritated and dried-out areas of the skin, leaving it smooth and totally moisturized.[65]

DOSAGE
Adults should take

- 1 to 2 teaspoons of Palash Churna with warm water and honey after meals in order to safely consume *BM*formulations each day.
- 10 – 20 ml of leaf juice
- 50 – 100 ml of bark decoction
- 3 – 6 grams of flower powder
- 3 – 6 grams of seed extracts
- 1 – 3 grams of gum resin.[65]

Conclusion:
It is well known that the phytochemicals in Butea monosperma exhibit vital pharmacological effects that show promise. This review can be used to find new therapeutic compounds with improved drug delivery system efficacy.

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