



## A REVIEW ON BRAMHAVRIKSHA: PLASH (*BUTEA MONOSPERMA*)

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### ABSTRACT

Herbs were used since ancient times for meeting the health needs of civilization and practice of herbal formulation existed in different regions of the world using different philosophies. In the current scientific age, it is absolutely necessary that *Ayurveda* should be an exploration and research work for recognition on world stage. Using modern techniques research on old misconceived ideas and medicinal species new scientific tools can be established in medicine making. There has been an increasing realization that the herbal drugs are effective but also safer and this has led to the spurt in the use of plant based medicine across the world and India too. There are opportunities in 21<sup>st</sup> century for developing countries like India with traditional knowledge base to develop globally acceptable herbal drugs/ nutraceuticals by convert their rich bio- resources and associated traditional knowledge systems for economic wealth and thereby bring prosperity to the nation. *Palash* (*Butea monosperma* Lamk. Taub), is medium-sized deciduous tree, 10-15 meters high belonging to the family Fabaceae, is found through- out India. . It is the most important plant for *Yajna* (ritual) according to *Vedic* literature. In India, in most of the regions it used in worship of God. In many festivals it is used in different way. According to an ancient science of life i.e. *Ayurveda*, there is always scientific theory behind celebrating any festivals and *Aacharyas* have scientific view for using any drug as medicine. This present review article contains spectrum of information about *Butea monosperma* under major heads general information, pharmacognostic, chemical, pharmacological, clinical studies with references.

**KEYWORDS:** Ayurveda, Palash, Herbal Drugs, Deciduous Tree, Pharmacognostic, Pharmacological.

### INTRODUCTION

According to *Maharshi Charak* all matter of the world are useful provided that those substances should be used by doing research carefully.

*Yatha Vanaushadhi Bhootam Jagati Kishchit Dravya Muplabhyte Tantan Yaktiyarth Chah Tanmami Pretya/ Evam Preestkarino Kushalabhavanti//....Charak / Susrutha*

The current review deals with components and application of such type of herbal medication.

#### Botanical classification<sup>[1]</sup>

Kingdom - Plantae (plants)

Subkingdom - Angiosperms

Superdivision - Eudicots

Division – Rosids

Order – Fabales

Family – Fabaceae

Genus - *Butea*

Species - *B.monosperma*

#### Vernacular names of Palash<sup>[2]</sup>

English-Flame of forest, Bastard teak, Hindi -Dhak, Palas, Assamese-Palash, Bengali-Palas, Palash Gaccha, Gujarati-Khakara, Khakda, Khakhado, Khakhar, Khakar, Kesuda, Kannada-Muttgamara, Muttag, Muttulu, Konkani-Palash, Malayalam- Plasu, Pilacham, Palashin, Palash, Marathi-Palas, Oriya-Porasur, Punjabi-Chichara, Dhak, Palas, Sanskrit- Palash, Kimshuk, Vakrapushpa, Bhramavruksha, Raktapushpa, Tamil-Palashmaram, Chamata, Telugu-Modugai, Paladu, Chettu, Bihari-Faras, Paras, Kashmiri-Dhak, Urdu-Dhak, Tesu.

**Properties (Rasapanchak)<sup>[3]</sup>** Flower -Ras -Tikta, Katu, Kashay, Guna -Laghu, Singdha, Veerya -Sheet, Vipaka - Madhur Doshagh- nata -Kaphapittashamaka Bark, Leaf, Seed, Gum –Rasa-Katu, Tikta, Kashay, Guna-Laghu, Ruksha, Veerya-Ushna Vipaka –Katu, Doshaghnata-Kaphavatashamak.

**Karyakarana meemamsa**<sup>[4]</sup> Palash is pungent (katu), bitter (tikta) and astringent (kashay) in taste (Rasa), pungent in the post digestive effect (vipaka) and has hot (ushna) potency (virya). It alleviates kapha and vata doshas, but aggravates the pitta doshas. The flowers of Palash are bitter, pungent and astringent in test, sweet in the post digestive effect and have cold potency. So it alleviates pitta and kapha dosha and vata doshas.

Palash (*Butea monosperma* Lamk.Taub)<sup>[5]</sup>, is medium-sized deciduous tree, 10-15 meters high belonging to the family Fabaceae, is found throughout India. There are four type of Palash viz. Rakta (red), Pita (yellow), Shweta (white) and Nila (blue) as mentioned by Narahari in Raj Nighantu.<sup>[6]</sup> Out of above varieties, Shweta and Nila are seldom available and Pita is rare. As Pita variety becomes endangered the abundantly available Rakta variety is used commonly in medicines and it is called as flame of forest. It is the most important plant for Yajna (ritual) according to Vedic literature. In India, in most of the regions it used in worship of God. In many festivals it is used in different way. According to an ancient science of life i.e. Ayurveda, there is always scientific theory behind celebrating any festivals and Acharyas have scientific view for using any drug as medicine. The use of Rakta Palash flowers used for 'Holi', i.e. festival of colour in India. The thought behind it was that, the colour prepared from flowers is natural, good for skin and has no any adverse effect. Though there is an evidence of the uses of Palash since ancient time its review was chosen for study.

### Drug review of Palash

**1. Historical Aspects:** The references of Palash tree are found in Vedic literatures. It is mentioned in Vedic literature that Palash tree is a form of 'Agnidevta' i.e. the god of fire. The dry stem of Palash was used to make sacred fire.<sup>[8]</sup> Since old ages this plant is used for ritual process in all ways. In Telangana, these flowers are specially used in the worship of lord Shiva on occasion of Shivratri. In Kerala, this is called as Plasu and Chamata. Chamata is the vernacular version of Sanskrit word Samidha, small pieces of wood that is used for Agnihotra or fire ritual. In Theravada Buddhism, it is said to have used as the tree for achieved enlightenment or Bodhi by second lord Buddha. As per history of Palash forests, dhak forests covered much of the doab area between the Ganges and Yamuna, but these were cleared for agriculture in the early 19th century as the English East Company increased tax demands on the peasants.<sup>[9]</sup> Nirukti-पलाशः |<sup>[10]</sup> Palash, 'the tree having beautiful and useful leaves'. Vyutpatti-कर्मणः |<sup>[11]</sup> The Sanskrit word 'Palash' literally means looks like a flesh or blood.<sup>[12]</sup>

**2. Vedic Era:-** The reference of Palash is found in Vedic literature. The use of Palash is common in Vedic period not only to treat diseases but also in

routine life and in holy rituals also. Samidha of this plant was used at that time for different Homa and Yadnyas.<sup>[13]</sup> According to 'Kaushik Sutra', Palasha is Medhajanam. Keshav told it was 'Sarvaroga Bheshaja' and it was also used in Krimi Roga.<sup>[14]</sup> In Rigveda, the de-cription of Palash is found by synonym i.e. Kim-shuk (Synonym of Palash) found on sukta 85 of adhyaya 7 of mandal 10. This synonym is given for Palash because of its attractive color of the flowers.<sup>[15]</sup> In Athervaveda, the reference of Palash is found in the context of wound healing. Here the synonym Parna is used for it.<sup>[16]</sup> In Upanishad, importance and description of Palash has been described. In this ancient text the flower of Palash described beautifully. It is mentioned that the flower looks like flesh because of its red color. In this tree there is the seat of Bramha, therefore this tree is most important among all vanaspati.

**3. Samhita Era:-** Charak Samhita: In Caraka Samhita, Palash is not described in Mahakasaya.<sup>[17]</sup> But it is mentioned in Sutra, Chikitsa, and Siddhi sthana for treating the diseases like Arsha, Atisar, etc. by the only name Palash in Charak Samhita. [Table no.1] Sushrut Samhita: In Susruta Samhita, Palash is described in Rodhradi, Muskakadi, Ambasthadi and Nyagrodhadi Gana.<sup>[18]</sup> [Table no.2] Kashyapa Samhita: In this Samhita kwath of Palash is used to give mukti from 'Sheetaputana grah' for kids. Ashtang Hridaya: In Astanga Hridaya, Palash is mentioned in Rodhradi, Muskakadi, Ambasthadi and Nyagrodhadi Gana.<sup>[19]</sup> In Astanga Sangraha, Palash is mentioned in Rodhradi, Muskakadi, Ambasthadi and Nyagrodhadi Gana.<sup>[20]</sup> References found in Chikitsa sthana-2/43- Raktapitta, Chikitsa sthana9/68- Atisar. Chakradutta: He has told utility of Palash same as Acharya Charak but he used Kimshuk as its synonym. Palash is also mentioned in Cikitsagranthas like Gadanigraha, Bhaishajya Ratnavali and Bhava-prakasha Samhita. 4. Nighantu Era: In Nighantu, many drugs have been described in detail by giving different synonyms and their properties and uses. The synonyms of Palash which are found in most of the Nighantu are Brahmavriksha, Kimshuka, Parna, Yajniya, Raktapuspa, Samidvara and Vatapotha etc. Many of the Nighantu have de-scribed the properties of Palash. i.e., the Rasa of Palash as 'tikta and kashaya', Virya ushna but flower of Palash is 'sheet' in nature. The fruit is laghu, ushna and used in Prameha, Arsha, Krmi and Vatakaphaja rogas, according to Bhavaprakash Nighantu.<sup>[21]</sup> While in Nighantu Adarsh, the rasa of Palash is katu, tikta, kasaya, virya- ushna, vipaka – katu, Dosaghnta-Kaphavatanasaka.<sup>[22]</sup>

**Table 1: Charak Samhita.**

<b>References</b>	<b>Adhyaya/ Shloka</b>	<b>Rogaghnata</b>
1.Sutra sthana	3/16	Kushtha
2.Chikitsa sthana	5/173	Raktagulma
3.Chikitsa sthana	9/122	Arsha
4.Chikitsa sthana	19/59-60	Atisaar
5.Siddhi sthana	3/44-45	Yonidosha

**Table 2: Sushruta Samhita.**

<b>Reference</b>	<b>Adhyaya/ Shloka</b>	<b>Rogaghnata</b>
1.Sutra sthana	45/121	Kapha- pitta prashman
2. Sutra sthana	46/196-197	Krimighna
3.Chikitsa sthana	5/18	Aptanaka
4.Chikitsa sthana	20/ 14	Vidarika
5.Uttartantra	10/9	Pittaj abhishanda
6.Uttartantra	12/50	Rakta abhishanda
7.Uttartantra	42/107	Paitic shool
8.Uttartantra	45/29	Raktapitta
9.Uttartantra	54/25	Krimighna

#### 4. Palash in Nighnatu

1) Raj nighnatu- Palash flowers and beeja are mentioned in Raj nighantu in Karviryadivarga for Kushtha and Pama (skin diseases) 2) Bhavaprakash nighnatu- Palash Flowers and Beeja in Vatadi varga as Krumighna and Kushtha 3) Dhanvantari nighnatu -

Navpatra in Aamradi varga for Pliha, Gulma, Grahani, Arsha and Beeja in Aamardi varga as Krumighna 4) Shodhal nighnatu -Kanda in Amradi varga as Ra- sayan and Beeja in Amradi as Krumighna 5) Madanpal nighantu- Flowers in Vatadi varga as Grahi and Beeja in Vatadi varga as Krumighna.

**Table no.3: Nighantu.**

<b>S.no.</b>	<b>Nighantu</b>	<b>Plant parts</b>	<b>Varga/ Shloka</b>	<b>Rogaghnata</b>
1.	Raj nighantu	Flowers	Karviryadi Varga/ 37	Kushtha
			Karviryadi Varga/ 37	Pama, Twacha roga
2.	Bhavaprakasha	Flowers	Vataadivarga/ 50	Krumighna
		Beeja	Vatadivarga/52	Kustha
3.	Dhanvantri	Navpatra	Aamradi/151	Pliha, gulma, grahni, Arsha
		Beeja	Aamradi/146	Krumighna
4.	Shodhal	Kanda	Amradi/536	Rasayana
		Beeja	Amradi/536	Krumighna
5.	Madanpal	Flowers	Vatadi varga/40	Grahi
		Beeja	Vatadi varga/40	Krumighna

**5. Modern Era:-** 1) Indian Material Medica<sup>[23]</sup> -The author of this book has mentioned vernacular names and chemical constituents of this drug. Flowers are indicated in many diseases.

2) Data base on medicinal plants used in Ayurveda Vol I<sup>[24]</sup>-Detail explanation regarding Palash plant has been given such as family, classical text, vernacular names, morphology, useful parts, along with pharmacognosy, chemical constituents, pharmacological activity, toxicology and therapeutic evaluation is explained.

3) Medicinal plants quality standards of Indian medicinal plants<sup>[25]</sup>-Description regarding plant is given and also all types of phytochemical tests are explained in details.

4) The Ayurvedic Pharmacopeia of India<sup>[26]</sup>-It includes pharmacopeial standard of Palash. Scientific data on Palash is available in this text.

5) Indian Medicinal Plants<sup>[27]</sup>-Palash is mentioned in this book including sanskrit meaning, paryay, properties, and uses of Palash. Synonyms of Palash and its interpretation Synonyms have lot of importance in Ayurveda. It originates from the properties and action of the drugs. Sometimes synonyms of the drug indicate specificity and specialty of the drug. Kimshuk -Flowers looks like beak of parrot, Palash -Leaves are beautiful, Triparna- Three foliate leaves, Rakta pushpa -Flowers are of red colour, Yadnyik- Used in yajna since vedic period, Beejs neha - Seeds are oily, Samidvara -Describing its usefulness in rituals as samidha, Krumighna- Pacifies krimi.

**Formulations and preparations**<sup>[28]</sup> Krimikuthar rasa, Mahanarayan taila, Janam ghutti, Palashbijadi churna, Palashkshara ghrita, Kunkumadi tailm.

**Doses<sup>[29]</sup>**- Decoction (bark)- 50-100ml, Juice (leaf)-10-20ml, Flower powder- 3-6gm, Gum -1-3gm, Seed powder - 3-6gm.

Morphological description-(  
<http://indiabiodiversity.org/species/show/31135>).

Flame of Forest is a medium sized tree, growing from 20 to 40 feet high and the trunk is usually crooked and twisted with irregular branches and rough, grey bark. The leaves are pinnate, with an 8-16 c.m petiole and three leaflets, each leaflet 10-20 c.m long.

#### Cyclicity

Leaf fall- January- February

Flowering- February- April

Fruiting- April – May

#### Reproduction-

Propagation Techniques- Direct sowing of seeds.

#### Dispersers

Self, pollinators ; Birds and rodent

#### Morphological description-

Flower- In terminal or axillary fascicled racemes and panicles; orange- scarlet.

Fruit- An oblong, compressed pod, indehiscent; seed 1.

Leaf arrangement- Alternate spiral

Leaf type- Trifoliate

Leaf Shape- Rhomboid or broadly ovate.

Leaf apex- obtuse-retuse

Leaf base- Cuneate

Leaf margin- Entire

#### Distribution

Global distribution- Tropical Asia

Indian Distribution- Through out India.

#### Miscellaneous Details

Intresting Facts- Trees when in full bloom with bright orange flowers glow like a flame in forest canopy. Flowers yield a bright yellow dye used during the Holi festival. Leaves are stitched together to make biodegradable plates.

#### Phytochemistry

BM contains various phytoconstituents like alkaloids, flavonoids, phenolic compounds, amino acids, glycosides, resin, saponin and steroids (Table 1). Here we have described various constituents present in different parts such as flower, gum, seed, leaves, bark and stem.

The constituents are as follows.

**Phytochemistry • Flower:** 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-7-O- $\alpha$ -L xylopyranosyl (1→3)-O- $\alpha$ -L-arabinopyranosyl-(1→4)-O- $\beta$ -D galacto pyranoside.<sup>[30,31]</sup>

- Gum:** Gum contains mucilaginous material, pyrocatechin and tannins.<sup>[32]</sup>

- Seed:** Oil contains polypeptidase, lypolytic enzymes, proteinase and proteolytic.<sup>[32]</sup> 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.<sup>[33]</sup> BM seeds contain fixed oil, mixed fatty acids, and unsaponifiable matter.<sup>[34]</sup>

- Resin:** Resin contains jalaric esters I, II and laccijalaric esters III, IV  $\alpha$  amyrin,  $\beta$ -sitosterone its glucoside and sucrose; lactone-nheneicosanoic acid- $\delta$ -lactone.<sup>[35]</sup>

- Saponin:** Saponin contains butein, butin, butrin, colourless isomeric flavanone and chalcones.<sup>[36]</sup>

- Leaves:** Leaves contain kino-oil containing oleic, linoleic acid, lignoceric acid and palmitic.<sup>[37]</sup>

- Stem:** Stems contain 12 dimethyl-8-oxo-octadec-11-enylcyclohexane, Stigmasterol- $\beta$ -D-glucopyranoside and nonacosanoic acid.<sup>[38]</sup>

- Bark:** 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.<sup>[37,38]</sup> Isolation from stem bark methanolic extract of BM gives two structurally related methoxyisoflavones; cajanin and isoformononetin.<sup>[39]</sup> 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.<sup>[40]</sup> The active constituent obtained from ethyl acetate and petroleum extracts of the stem bark of BM was medicarpin.<sup>[41]</sup>

**Table 3: Active Principles in different parts of *Butea monosperma*.**

S.no.	Plant parts	Active Principles
1.	Flowers	Triterpene, Glycoside
2.	Gum	Tannin
3.	Seed	Enzymes
4.	Resin	Ester
5.	Saponin	Polyphenols
6.	Leaves	Fatty acid
7.	Barks	Aminoacids
8.	Stem	Steroids

#### Pharmacological Properties of *Butea monosperma*

Various parts of BM possess several pharmacological actions (Table 2). We have segregated multiple medicinal properties of different parts of BM such as leaves, flower, seed, bark and fruits. The actions of various parts of BM are as follows.

#### Leaves

**Antifilarial:** Aqueous extract of BM significantly inhibited the motility of microfilariae (*Brugia malayi*). This effect was seen in a dose dependent manner with IC50 value at 83ng/ml.<sup>[42]</sup>

**Antidiabetic:** Alloxan was used to induce diabetes in male rat. Oral administration of ethanolic extract of BM leaves showed antidiabetic activity. BM extract significantly lowers the blood glucose level and increased the activities of antioxidant enzymes upon treatment at 300mg/kg dose for continuous 45 days, which suggested that BM leaves have significant antioxidant and hypoglycemic effects.<sup>[43,44]</sup>

**Anti-inflammatory and anti-oxidant:** Different extracts of BM leaves showed anti-inflammatory activity in human red blood cells (HRBC) membrane stabilizing method. The petroleum ether and chloroform extract exhibited significant anti-inflammatory effects whereas hexane, ethyl acetate and ethanol extracts showed moderate antioxidant effects and anti-inflammatory activity.<sup>[45,46]</sup>

#### Flowers

**Anti-cancer:** Aqueous extract of BM showed anticancer activities by accumulation of cells in G1 phase and inhibiting cell proliferation with significant induction of apoptotic cell death suggesting anticancer properties of BM.<sup>[47]</sup>

- **Anticonvulsant:** Petroleum ether extract of BM has been fractionated with varying polarity such as ethyl acetate, n-hexane and methanol by column chromatography. Fractionated part of petroleum extract of BM exhibited anticonvulsant activity against seizures induced by maximum electroshock (MES), Pentylenetetrazole (PTZ) and lithiumsulfate- pilocarpine nitrate. Additionally, triterpene present in BM exhibited anti-depressant effect.<sup>[48]</sup>

**Antidiabetic:** 50% ethanolic extract of BM flowers possess significant antidiabetic activity against alloxan-induced diabetes in wistar rats. The Antihyperglycemic and antioxidant potential ethanolic extract of BM showed antidiabetic activity by reducing the level of total cholesterol, triglyceride and very low-density lipoprotein cholesterol.<sup>[49]</sup> The oxidative harm in the various organ like pancreas, liver and kidneys of diabetic mice shown by a remarkable elevation in thiobarbituric acid level and a distinct diminution in glutathione content was abolished by ethanolic extract of BM. Anti-diabetic and anti-oxidant activity of BM may be attributed due to the presence of flavonoids, saponins and sterols.<sup>[50]</sup>

#### Anti-inflammatory and antioxidant effects

Methanolic extract of BM (600 mg/kg and 800 mg/kg) showed anti-inflammatory effect which was dose dependent. It inhibited the paw edema and granuloma in carrageenan induced paw edema and cotton pellet granuloma model in rats.<sup>[51]</sup> This may be due to the presence of various polyphenols like butrin, isobutrin, isocoreopsin, and butein in BM.<sup>[52]</sup>

**Antimycobacterial activity**-BM flowers contain bioactive flavonoids such as dihydromonospermoxide,

dihydrochalcone, monospermoxide, isoliquiritigenin and butein showed antimycobacterial activity.<sup>[53]</sup> The study revealed its antifungal activity against various fungal species.<sup>[54]</sup> Antimicrobial activity 5,7-dihydroxy -3,6,4-trimethoxy flavone-7-O- $\alpha$ -L xylopyranosyl (1 $\rightarrow$ 3)-O- $\alpha$ -L-arabinopyranosyl-(1 $\rightarrow$ 4)-O- $\beta$ -D galactopyranoside showed antimicrobial activity. Seed oil of BM possess antimicrobial potential against pathogenic bacteria and fungi. So the oil has fungicidal and bactericidal properties.<sup>[55]</sup>

**Antimicrobial activity** Isoflavone isolated methanolic extract of BM which showed antidopaminergic activity and inhibit the foot shock-induced aggression in rats and potentiated haloperidol-induced catalepsy in a dose dependent manner.<sup>[56]</sup>

**Antidopaminergic activity Hepatoprotective** effect of flowers of BM aqueous extract (200, 400, 800 mg/kg, p.o.) was examined against CCl4 (1.5 ml/kg i.p.) induced hepatotoxicity. CCl4 has the ability to cause liver cirrhosis and necrosis. Therefore CCl4 administration significantly changed number of biochemical parameters such as albumin, protein, hepatic lipid peroxidation, reduced glutathione and total protein levels. It was witnessed that BM has restored all the altered biochemical parameters including histopathological alterations in dose dependent manner.<sup>[57]</sup>

**Free radical scavenging effect-** The methanolic extract of flower part of BM showed free radical scavenging effect which was evaluated followed by 2,2 diphenyl-1-picrylhydrazyl (DPPH) radical, superoxide dismutase (SOD) assay. In addition, inhibition of erythrocytes hemolysis was also evaluated by 2, 2' azo-bis (amid inopropane) dihydrochloride (AAPH) antioxidant assay. These effect may be due to presence of higher phenolic contents in the extract.<sup>[58]</sup>

**Seeds:** • **Hormone balancing effect:** Alcoholic extract of BM possess antiestrogenic effect and anti-implantation activities. However, the estrogenic activity is due to the presence of active constituents like Butin which also exhibits male contraceptive properties. Methanolic extracts of BM seed also possess antifertility effect and uterine peroxidase activities.<sup>[59]</sup>

- **Anti-implantation activity:** Butin is an active compound of BM. Oral administration of Butin at the doses of 5, 10 and 20 mg/rat showed anti-implantation activity. A dose dependent response was seen during termination of pregnancy. Further, at lower doses, a decrease in the quantity of implantation sites was also noticed. Butin has estrogenic activity at comparable anticonceptive doses observed in ovariectomized young female rats but was devoid of antiestrogenic activity.<sup>[60]</sup>

- **Anthelmintic effect:** The methanolic extract of BM seeds possess significant anthelmintic activity against *Caenorhabditis elegans*.<sup>[61]</sup> The anthelmintic activity

against Trichostrongylid nematodes in sheep strongly corroborate this finding. The methanolic extract of crude powder obtained from the seeds of BM (1, 2 and 3mg/kg) showed anthelmintic effect. Time and dose dependency was noticed.<sup>[62]</sup> In addition extract of same solvent also possess significant anthelmintic activity.

- Anti-hyperglycemic and Anti-hyperlipidemic:** The ethanolic extract obtained from BM seeds possess antidiabetic, anti-hyperlipidemic and antiperoxidative effects. The ethanolic extract treated for four weeks exhibit significant antihyperglycemic effect with improved glucose tolerance in non-insulin dependent diabetic (NIDDM) rats.<sup>[63]</sup>

- Antiviral:** Flavone glycoside isolated from the seeds possess potential antiviral properties.<sup>[33]</sup>

- Antimicrobial activity:** BM seed oil showed a significant fungicidal and bactericidal effect in vitro which may be due to the presence of active constituents like medicarpin.<sup>[64]</sup>

- Anti-inflammatory:** Cotton pellet induced granuloma and carrageenin-induced paw oedema method were used for the evaluation of antiinflammatory activity. The study revealed that on oral administration of BM seed extract possess significant anti-inflammatory effects which may be due to presence of fixed oil, mixed fatty acids, and unsaponifiable matter present in the BM extract.<sup>[65]</sup>

### Barks

- Anti-diarrhoeal:** Ethanolic extract of bark and stem parts of BM have potential anti-diarrhoeal activity against castor oil induced diarrhea and PGE2 induced enteropooling in rats. Oral administration of charcoal meal along with BM extract showed remarkable decrease in gastrointestinal motility.<sup>[66]</sup>

- Wound healing activity:** Ethanolic extract of BM bark possesses wound healing effect in rats.<sup>[67]</sup> It accelerated the wound healing effect when administered topically on full excision wounds made on the back of rats. The ethanolic extract of BM increased collagen synthesis as well as cellular proliferation at the wound infected area. The extract increased the wound contraction and decreased epithelialization time in excision wound model, increased the hydroxyproline content, granulation tissue weight and tensile strength of the incision wound area.<sup>[68]</sup>

- Osteogenic and Osteoprotective activity:** Cajanin isolated from stem bark methanolic extract of BM possesse differentiation-promoting as well as powerful mitogenic effects on osteoblasts. However, isoformononetin was found to have potent anti-apoptotic effect and osteoblast differentiation promoting effects.<sup>[69]</sup> Stem bark extract of BM possesses osteogenic and osteoprotective properties.<sup>[39, 70]</sup>

- Anti-inflammatory:** 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.<sup>[71]</sup>

- 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.<sup>[72]</sup>

- 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 increase in the level of superoxide dismutase, glutathione and catalase as well as decrease in hepatic lipid peroxidation upon the treatment suggesting promising thyroid inhibitory and hypoglycemic effects of Stigmasterol.<sup>[73]</sup>

- Anti-fungal:** Medicarpin had greater antifungal activity than the standard fungicide Benlate against *Cladosporium cladosporioides*.<sup>[74]</sup>

- Anti-ulcer:** Methanolic extract of BM bark at 500mg/kg showed 79.30 and 82.20% healing against ethanol and aspirin induced gastric ulcerations respectively signifying free radical scavenging properties of the extract for anti-ulcer effect.<sup>[75]</sup>

### Fruits

- Hypoglycemic effect:** BM methanolic extract showed significant decrease in blood urine sugar, plasma glycoprotein and glucose levels upon treatment (3g/30ml of water for 30 days). Moreover, there was reduction in lipid profile and the restoration of activities of liver enzymes suggesting potential anti-diabetic effects of BM fruit extract.<sup>[76]</sup> The study revealed that herbal formulations consisting of three plant parts; Piper betel, Butea monosperma and Trigonella foenum graecum have anti-diabetic potential in control and alloxan induced diabetic rats.<sup>[77,78]</sup>

- Antimicrobial and anti-fungal:** Different fractions obtained from BM possesses significant antimicrobial effects across various bacterial and fungal species.<sup>[55,79,80]</sup>

- Antihelminthic effect:** Pippali rasayana containing the extract of BM for the evaluation of immuno-stimulatory and antigiardial activity against *Giardia lamblia* and they has observed about 98% recovery from the infection. However, in vitro study suggested that rasayana had no homicide effect over the parasite which showed significant activation of macrophages which is an indication of elevated level of macrophages migration index (MMI). BM extract (900mg/kg) also exhibited

phagocytic activity. In addition, they administered Pippali Rasayana orally 1g, for 15 days duration and they noticed that here was an absolute absence of Giardia

lamblia form the patients (25 treated, 25 placebo controls).<sup>[81]</sup>

**Table 4: The active principles obtained from this plant parts possess various biological activity have been tabulated in brief.**

S.no.	Plant parts	Extract	Pharmacological action
1.	<b>Leaves</b>	Aqueous	Anti-filarial
		Ethanolic	Antidiabetic, antioxidant
		Petroleum ether, Chloroform	Anti-inflammatory, anti-oxidant
2.	<b>Flowers</b>	Aqueous	Anticancer, Hepatoprotective
		Petroleum	Anticonvulsant
		Ethanolic	Antihyperglycemic, anti-oxidant
		Methanolic	Anti-inflammatory, anti-dopaminergic activity, Free radical scavenging effect
3.	<b>Seeds</b>	Alcoholic	Harmone balancing effect
		Methanolic	Anti-fertility, anti-helminitics effect
		Ethanolic	Anti-hyperglycemic,Anti-hyperlipidemic
4.	<b>Bark</b>	Ethanolic	Anti-diarrhoeal, wound healing activity, anti- stress effect
		Methanolic	Osteogenic and Osteoprotective activity, Anti- inflammatory, Anti-ulcer, effects on hormonal level.
5	<b>Fruits</b>	Methanolic	Hypoglycemic effect
		Pippali rasayana	Antihelminthic effect

## COCLUSION

Using modern techniques research on old misconceived ideas and medicinal species new scientific tools can be established in medicine making. There has been an increasing realization that the herbal drugs are effective but also safer and this has led to the spurt in the use of plant based medicine across the world. This review article contains spectrum of information about *Butea monosperma* under major heads general information, pharmacognostic, chemical, Pharmacological, clinical studies with references.

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