

## A REVIEW: PHYTOCHEMICAL AND PHARMACOLOGICAL EVALUATION OF *BUTEA MONOSPERMA* PLANT

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### ABSTRACT

*Butea monosperma* (BM) is a well-known medicinal plant which is a moderate sized deciduous tree and widely distributed in India, Ceylon and Burma. Since ancient times, plants have been widely utilized for their medicinal and aesthetic properties. In India, traditional herbal medicine has a long and rich history, and plant-based remedies continue to be extensively practiced in various traditional healthcare systems. *Butea monosperma* Taub., commonly known as the “Flame of the Forest,” is one such medicinal plant that has been used for centuries in traditional Asian medicine. Although it possesses significant therapeutic potential, comprehensive scientific studies on this plant remain relatively limited. Therefore, the present review aims to compile and present updated information regarding the botany, morphology, ecological

distribution, ethnobotanical uses, phytochemical constituents, and pharmacological activities of different parts of the plant. Traditionally, various parts of the plant have been used in the treatment of numerous ailments, including diabetes, cancer, diarrhoea, dysentery, fever, and jaundice. Modern pharmacological investigations have revealed a wide range of biological activities associated with the plant, such as anti-inflammatory, antimicrobial, antifungal, antibacterial, antistress, chemopreventive, haemagglutinating, hepatoprotective, antioxidant (radical scavenging), thyroid inhibitory, antiperoxidative, hypoglycemic, and wound-healing effects. Additionally, the plant has also been reported to exhibit anticonvulsant, antidiarrheal, antiestrogenic, and antifertility properties. Morphologically, the plant is characterized by large, stipulate, trifoliate leaves and is widely distributed across tropical and subtropical

regions. Phytochemical investigations of different *Butea* species have identified the presence of several bioactive compounds, including flavonoids, sterols, alkaloids, imides, and lactones, which are believed to contribute to its diverse pharmacological activities. The present review provides a comprehensive overview of the morphology, ethnobotany, phytochemical composition, traditional applications, plant-derived products, and pharmacological properties associated with various parts of this important medicinal plant.

**KEYWORDS:** *Butea monosperma*, flavonoids, antioxidant, Pharmacology.

## INTRODUCTION

Plants have been used for their therapeutic and cosmetic properties since ancient times. India, in particular, has a rich heritage of documented herbal medicine. This review focuses on *Butea monosperma* Taub., commonly known as Flame of the Forest, highlighting its botany, morphology, ecological distribution, medicinal uses, phytochemistry, and pharmacological activities, as research on this species remains limited.<sup>[1]</sup>

It is estimated that 70-80% of people in rural areas of developing and underdeveloped countries still rely primarily on medicinal plants for healthcare. *Butea monosperma*, a member of the Fabaceae family, is known by various local names such as khakara, chichra, dhak, palash, mutthuga, bijasneha, Bastard Teak, and Bengal Kino. The species is widely distributed across India, Myanmar, and Sri Lanka, excluding highly arid regions. It grows both sporadically in mixed forests and abundantly in open grasslands, thriving in dry as well as irrigated areas.<sup>[2]</sup>

Rank	Scientific Name <sup>[5]</sup>
Kingdom	Plantae
Sub-kingdom	Tracheobionta
Super-division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Fabales
Family	Fabaceae
Genus	<i>Butea</i>
Species	<i>Butea monosperma</i> (Lam.) Taub.

## Botanical description<sup>[14]</sup>

*Butea monosperma* is an erect tree reaching 12–15 m in height, with a crooked trunk and irregularly spreading branches. The bark is rough and ash-colored, while young shoots are

covered with fine downy hairs. The leaves are trifoliate with petioles measuring 10–15 cm in length and linear-lanceolate stipules.

Leaflets are coriaceous; the terminal leaflet is broadly ovate, 10–20 cm long with a cuneate base, while the lateral leaflets are smaller, 10-15 × 7.5-10 cm, obliquely rounded at the base and equilateral, with the lower side slightly larger. All leaflets are obtuse at the apex and glabrous on the upper surface.

**Phytochemistry:** BM contains various phytoconstituents like alkaloids, flavonoids, phenolic compounds, amino acids, glycosides, resin, saponin and steroids. Here we have described various constituents present in different parts such as flower, gum, seed, leaves, bark and stem. The constituents are as follows:

**Flower:** The phytochemical composition includes triterpenes along with important flavonoid derivatives such as butrin, isobutrin, coreopsin, sulphurein, and isocoreopsin. Additionally, compounds like monospermoside, isomonospermoside, auronones, steroids, and various flavonoids have been identified. A notable glycoside present in *Butea monosperma* is characterized as 5,7-dihydroxy-3,6,4'-trimethoxyflavone-7-O- $\alpha$ -L-xylopyranosyl-(1→3)-O- $\alpha$ -L-arabinopyranosyl-(1→4)-O- $\beta$ -D-galactopyranoside.<sup>[18-19]</sup>

**Gum:** Gum contains mucilaginous material, pyrocatechin and tannins.<sup>[20]</sup>

**Seed:** Oil contains polypeptidase, lipolytic enzymes, proteinase and proteolytic. Palasonin and nitrogenous acidic compounds are 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>[20]</sup>

**Stem:** Stems contain 12 dimethyl-8-oxo-octadec-11-enylcyclohexane, Stigmasterol- $\beta$ -D- and nonacosanoic acid.<sup>[21]</sup>



**Fig. 1:** *Butea monosperma*.

### Morphological Characters<sup>[10]</sup>

*Butea monosperma* Taub. is an erect, medium-sized deciduous tree that typically grows to a height of about 12-15 m. The tree possesses a crooked trunk with irregularly spreading branches. Young shoots are covered with grey or brown silky pubescence. The bark is generally ash-coloured, fibrous in texture, and ranges from bluish-grey to light brown in colour. When injured, the bark exudes a characteristic reddish gum.

The leaves are large, trifoliate, and stipulate. The petiole measures approximately 10-15 cm in length. The leaflets are obtuse, glabrous on the upper surface, and finely silky beneath with a prominently reticulate venation. The base of the leaflets is cuneate or deltoid.

The flowers are bright orange-red in colour and are covered externally with silky, silvery hairs. The corolla is elongated and conspicuous. The stamens are diadelphous with uniform anthers. The ovary contains two ovules, with a filiform and curved style and a capitate stigma.

The fruit is a pod that is densely pubescent (canescent), narrow, and thickened along the sutures. The pod usually contains a single apical seed and splits around the seed while the lower part remains indehiscent. The seeds are flat, kidney-shaped (reniform), and slightly curved.

The tree is relatively slow-growing and may attain a height of about 5-8 m with a trunk diameter of approximately 20-40 cm at maturity, which may occur around 50 years of age.

### Pharmacological activities

**Antimicrobial activity:** A study evaluated the physico-chemical properties, quantitative phytochemical composition, and antibacterial activity of *Butea monosperma*. Extracts of the

plant prepared using ethanol, chloroform, and petroleum ether were tested against *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus subtilis*. The ethanol extract exhibited significant activity against *S. aureus* and *B. subtilis*, while petroleum ether extract failed to inhibit *P. aeruginosa*. None of the extracts showed activity against *E. coli*. The antibacterial effect of *B. monosperma* was comparable to that of ampicillin, a standard antibacterial drug. These findings suggest that *B. monosperma* could serve as a complementary therapeutic agent alongside conventional antibiotics.<sup>[11]</sup>

**Anti-diarrhoeal activity:** The anti-diarrhoeal activity of the ethanolic stem bark extract of *Butea monosperma* (Lam.) was evaluated using various experimental models in Wistar albino rats. The extract effectively inhibited castor oil-induced diarrhea and PGE<sub>2</sub>-induced enteropooling, and also reduced gastrointestinal motility in the charcoal meal test. These findings support the traditional use of *B. monosperma* stem bark as a non-specific herbal remedy for diarrhea.<sup>[12]</sup>

**Antidiabetic activity:** In a study on male rats, diabetes was induced using alloxan, and the ethanolic extract of *Butea monosperma* leaves was administered orally. After 45 days of treatment at a dose of 300 mg/kg, the extract significantly reduced blood glucose levels and enhanced the activity of antioxidant enzymes, indicating that *B. monosperma* leaves possess potent hypoglycemic and antioxidant properties.<sup>[12]</sup>

**Anticonvulsant activity:** The petroleum ether extract of *Butea monosperma* (BM) was fractionated using solvents of varying polarity, including ethyl acetate, n-hexane, and methanol, via column chromatography. The fractionated petroleum ether extract demonstrated significant anticonvulsant activity against seizures induced by maximum electroshock (MES), pentylenetetrazole (PTZ), and lithium sulfate-pilocarpine nitrate models. Additionally, triterpenes present in *B. monosperma* were found to exhibit notable antidepressant effects.<sup>[13]</sup>

**The antidopaminergic activity:** have studied the antidopaminergic activity of the methanolic extract of *B. monosperma* flowers. The antidopaminergic activity is present in the isoflavone isolated from ethyl acetate soluble fraction of methanolic extract which inhibited the foot shock-induced aggression in rats and potentiated haloperidol-induced catalepsy in a dose dependent mann.<sup>[14]</sup>

**Antifungal activity:** The stem bark of *B. monosperma* exhibited antifungal action against *Cladosporium cladosporioide* when extracted with ethyl acetate and petroleum. The antifungal activity is caused by an active component called (-)-medicarpin. In vitro study of *Butea monosperma* seed oil revealed considerable bactericidal and fungicidal effects.<sup>[15]</sup>

**Anti-inflammatory activity:** Several animal studies have demonstrated the anti-inflammatory activity of *Butea monosperma* extracts using models such as carrageenan-induced paw edema and cotton pellet-induced granuloma formation. Treatment with the extracts resulted in significant reductions in inflammatory markers and tissue damage, supporting their potential as anti-inflammatory agents.<sup>[5]</sup>

**Wound healing:** The ethanolic extract of the bark of *Butea monosperma* has been reported to possess significant wound-healing activity. In experimental studies, the extract was applied topically to excision wounds on the backs of rats, which resulted in an accelerated wound-healing process. The enhanced healing effect was confirmed by an increase in DNA content, total protein levels, and collagen deposition in the granulation tissue, indicating improved cellular proliferation and collagen synthesis at the wound site.

Furthermore, the results demonstrated a significant increase in the tensile strength of incision wounds compared with the control group. The treatment also led to an increase in granulation tissue weight and hydroxyproline content, which are important indicators of collagen formation. In the excision wound model, the extract promoted faster wound contraction and reduced the epithelialization period.<sup>[16]</sup>

## CONCLUSION

*Butea monosperma* possesses a wide range of medicinal properties and therapeutic applications that merit further investigation through modern scientific approaches. Numerous studies support its traditional uses and highlight its potential pharmacological benefits. The available evidence suggests that this plant could serve as a valuable source of bioactive compounds with significant therapeutic potential.

Further systematic research, including phytochemical, pharmacological, and clinical studies, is required to fully elucidate its mechanisms of action and validate its efficacy and safety. Such investigations may facilitate the development of novel plant-based formulations and promote the integration of *Butea monosperma* into modern complementary and alternative

medicine systems. Continued scientific exploration may therefore enhance its utilization in contemporary healthcare and therapeutic strategies

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