



A comprehensive review on *Butea monosperma*: A valuable traditional plant

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Abstract

Butea monosperma, belonging to the family of *fabaceae*, also popularly known as Flame of Forest, Bastard teak. The family *fabaceae* consists of 630 genera and 18000 species which is scattered through out India, Bangladesh, Pakistan, Srilanka, Nepal, Myanmar. This plant is used for treatment of various diseases from ancient days to now a day. The main constituents of this plant includes flavonoids, triterpene, alkaloids, sterols, lipid, inorganic and proteins, which are responsible for biological and pharmacological activities such as anti-hyperglycemic, anti-tumorous, anti-cancerous, anti-oxidant, woundhealing activity, anti-malarial immunomodulatory. *Butea monosperma* is widely used in Ayurveda and has become a treasure of modern medicine. The present study accumulates information on different facets of *Butea monosperma* and its prospective uses.

Keywords: *Butea monosperma*, phytochemical constituents, pharmacological activities

Introduction

From the classical times the nature stands a golden mark and provided the armory of remedies to cure all ailments of mankind. Herbs have always been the predominant form of medicine in India and currently they are becoming popular globally. India has an age old system of medicine known as Ayurveda system along with some other traditional system such as Siddha and Unani. There is rampant change in the international interest of herbal medicines [1]. Medicinal plants play a major role in research and new drug development in the field of pharmaceutical science. *Butea monosperma*, is a moderate sized deciduous tree, belonging to *fabaceae* family. It is known as The Flame of forest or Bastard teak in English and Palash or dhak in Hindi They consists one of the largest families of flowering plants with 630 genera and 18000 species. The genus *Butea* includes *Butea monosperma* parviflora, *Butea minor* and *Butea superba* widely distributed throughout India. It is elucidated in Upanishads, Vedas, Susripta Samhita, Charaka Samhita, Astanga Sangraha, Ashtanga Hrdaya [2]. This is a moderate sized deciduous tree which is widely distributed throughout India, Burma and Ceylon extending in the north west Himalayas as far as Jhelum except in very acrid parts [3]. It is considered as a sacred tree. It grows well in the alkaline, marshy condition in sunny location. The number of different chemical constituents obtained from various parts of the plant are used as anti-inflammatory, anti-diabetic, anti-fungal, anti-asthmatic, astringent, aphrodisiac [4]. The gum which is obtained from the slit made on the bark of the tree is known as 'kamarkas' or Bengal Kino which is rich source of tannins. The dyeing agent present in the flowers that imparts its color is used as insecticide and coloring agent The flavonoids Butin, Butein, Butrin, Isobutrin, Palasitrin, Coreopsin, Isocoreopsin, Sulphuresin, Monospermoside, Isomonospermoside and 7,3,4-trihydroxyflavone have been isolated from the flower of this

plant. From the stem and the pods of this plant species Euphane triterpenoid 3 α -hydroxyeuph-25-ene and the alcohol 2, 14-dihydroxy-11, 12-dimethyl-8-oxo-octadec-11-enylcyclohexane and Imide palasimide has been isolated respectively [7]. It acts as the host for lac insect and plays a role in the production of lac [5]. Bark fibers are utilized for making cordage. Wood pulp is useful for newsprint manufacturing [6]. According to the traditional system of medicine the plant is a revitalizer. Owing to its multifaceted attributes, this plant is a multifunctional tree with massive therapeutic and commercial value.



Fig 1: Showing the Plant & the Flowering Plant of *Butea monosperma*

Common Names in India [8]

Sanskrit: Palasah

Hindi: Dhak, palas

English: Bastard Teak, Parrot Tree

Bengali: Palas, Polashi

Gujarati: Khakharo

Marathi: Kakracha

Telugu: Mooduga, palasamu

Tamil: Parasa

Kannada: Muttuga

Malayalam: Brahmavriksham, kimshukam

Synonyms of *Butea monosperma* [9]

- Palash* – The leaves are fleshy and beautiful.
- Kinshuka* - Resembling parrot's beak.
- Ksharashrestha* - The plant is one of the best among the sources of alkali.
- Parna* - The Leaves are useful.
- Brahmavrksa* - Used in religious rites and sacrifices.
- Yajniya* - Used in `religious rituals.
- Raktapuspa* - Flowers are red.
- Vatapotha* - It pacifies vata.
- Samidvara* - As it is useful in Yajna.
- Putadru*-It is sacred tree.
- Kharaparna*- The leaves are rough to touch.
- Bijanasha*: Seeds (beej) are oily
- Vakrapushpa*: Its flowers (pushpa) are curved
- Putadra*: Sacred tree
- Krmighna*: Potent anthelmintic drug
- Triparna (Leaf of sacred Bael)*: Trifoliolate leaves

Botanical Classification [10, 11]

- Kingdom: Plantae
- Sub-Kingdom: Tracheobionta
- Division: Magnoliophyta
- Class: Magnoliopsida
- Sub class: Rosidiae
- Order: Fables
- Family: *Fabaceae*
- Genus: *Butea*
- Species: *monosperma*

Distribution of plant

This plant is widely distributed in tropical and subtropical regions of Indian subcontinent. It is common in the south-East Asia ranging from India, Bangladesh, Pakistan, Nepal, SriLanka, Myanmar, Indonesia, Malaysia, and Vietnam [12]. It is very common throughout the greater part of the India up to 1000 MSL(minimum sea level) or higher in the outer Himalaya, Khandesh Akrani up to 1200 and Hill of South India up to 1300 m. It is especially found in Maharashtra: Kolhapur, Karnataka: Chikmagalur, Coorg, Mysore, Shimoga, Kanara, Kerala: Alapuzha, Idukki, kasaragod, kollam, Kozhikode, Malapuram, Palakkad, Rajastha N: Jaipur, Udaipur, Kota in throughout India [13, 14].

Ecology

Butea monosperma is a plant which is generally found in the drier parts of the India. Despite the fact that the tree is drought resistant but the leaves turn white and fall off. The plant can sustain in those areas which have an annual rainfall of 450-4500 mm [11]. It can also grow on various types of soils like black cotton soil, clay loam, shallow, and even waterlogged soils. It shows capability to reproduce from seed and root sucker. The seedling of this plant can flourish best in rich loamy soil with pH ranging 6 to 7 under high temperature and relative humidity [15]. For cultivation; the pods may be planted at a distance of 25-30 cm apart along the lines and lightly covered with soil. Another way, the plants are raised at 10 x 10 cm distance in the nursery by dispersing the ripe seeds

before the rainy season. Daily watering and weeding is carried out and the seedlings are transplanted during the rainy season after the stem is trimmed to 5 cm. Clonal propagation by air layering aids in the quick formation of plantation of this tree. It was discovered that the growth of seedlings of palash was better in pure black soil [16].



Fig 2: showing the flower and bark of *Butea monosperma*

Botanical Description

Butea monosperma is a bolt upright tree which is about 12-15 m high with contorted trunk and irregular branches. The bark is rough, fibrous and it exudes reddish brown juice on injury. Wood is gray in color with no annual rings. Medullary rays are broad and the darker tissues between the rays is broken up into oblong patches by concentric bands of pale tissues. Leaves are three foliate, large and stipulate. Petiole is 10-15 cm long and stout, stipel is subulate, deciduous. Leaflets are all obtuse, glabrous above when old, finely silky and conspicuously articulately veined beneath with connate or deltoid base. Calyx is 12mm long, dark, olive green to brown in color, have silky hairs from within, teeth short, two upper connate and the lower three are equivalent and triangle in shape. They are densely pubescent. Flowers are large, in a rigid racemes (Flowers have an indeterminate type of inflorescence and are borne on short pedicels lying along a common axis. This type of inflorescence is known as raceme. About 15 cm long, three flowers together form the tumid nodes of the dark olive-green velvety rachis. Corolla is 3.8-5 cm long, covered with silky, silvery hairs on outside and bright orange red. Stamens are diadelphes, uniform anthers. Ovary is with two ovules, style filiform, curved and stigma capitates. Pods stalked 12.5-20 by 2.5- 5 cm, thickened at the sutures, reticulate veined argenteocanesent stalked 2 cm long. Leaflets are obtuse, glabrous above, finely silky and conspicuously reticulately veined beneath with connate or deltoid base. Calyx is dark, olive green to brown in colour and densely velvety outside. The corolla is long with silky silvery hairs outside and bright orange red. Stamens are diadelphes, anthers uniform. Ovary 2 ovule, style filiform, curved and stigma capitates. Pods, argenteocanesent, stalked 2cm long, covered with brown hairs, thickened at the sutures, splitting round the single apical seed, lowest part indehiscent. The seed is 3cm flat, reniform, brown, smooth. The leaves begin to fall off during November-December and by the end of January the tree is leafless or nearly so. The new leaves come into view in April or early May. Flowering starts in January and continues till the end of April, according to the locality. The pods with a seed each at the apex ripen during May-June [17, 18, 19, 20, 21, 22, 23].

Phytochemical constituents present in different parts of plant

Flower- The flower contain triterpenes [24], flavonoids like butein, butin, isobutrin, coreospin, isocoreospin, sulphuretin, monospermoside and isospermoside, dihydromonospermoside, chalcones, aurones, isobutyne [25]. The major glycoside of the flower is butrin. The bright color of the flower is due to the presence of chalcones and aurones [11]. It also contains paltitrin, histidine, aspartic acid, alanine of phenyl-1-alanine, myricylalcohol, stearic, palmitic, arachidic and lignoceric acids, fructose, glucose, aspartic acid, alanine and phenylalanine [26-27] and a new bioactive flavonoid glycoside (5,7-dihydroxy-3,6,4'-trimethoxyflavone-7-O- α -L-xylopyranosyl-(1 \rightarrow 3)-O- α -L-arabinopyranosyl-(1 \rightarrow 4)-O- β -D-galactopyranoside) [11].

Bark-The bark contains Kino-tannic acid, gallic acid, pyrocatechin, paltitrin and major glycosides like butrin, alanine, allophonic acid, butolic acid, cyaniding, histidine, lupenone, lupeol, miroestrol, palasimide, shelloic acid, medicarpin [27, 28, 29, 30]. Two compounds, 3, 9-dimethoxypterocarpan, and triterpenoid ester, 3 α -hydroxyeuph-25-enyl heptacosanoate [31].

Leaf- The leaves contains glucoside, kino-oil that containing palmitic acid, lignoceric acid, oleic and linoleic acid [27].

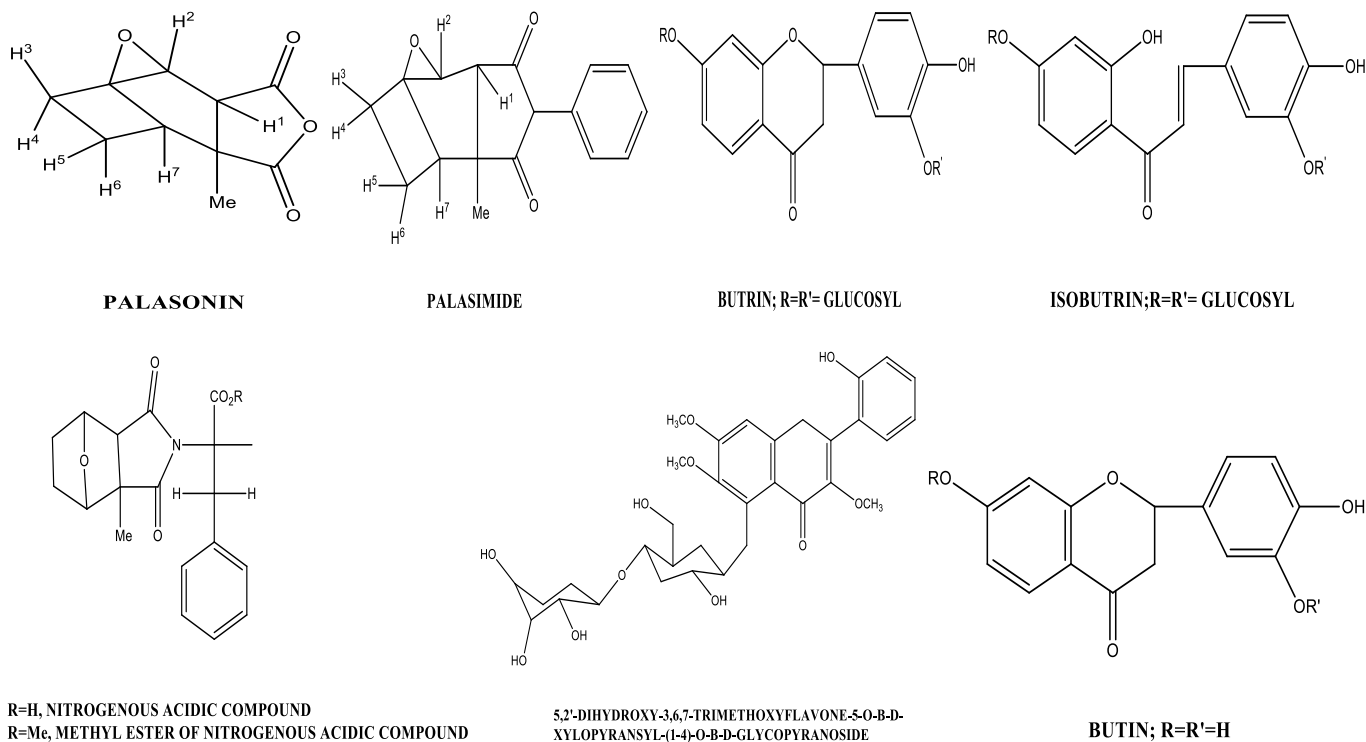
Seed- The seeds contain up to 20% of a fatty oil known as Moodooga Oil or Kino-Tree oil. The fresh seeds contain lipolytic and proteolytic enzymes plant proteionase and

polypeptidase [2]. A nitrogenous acidic compound, along with palasonin and monospermoside (butein-3-O-D-glucoside) is also present in the seeds [25, 35]. α -amyrin, β -sitosterol, β -sitosterol- β -D-glucopyranoside and sucrose [28], monospermin, phosphatidyl choline, phosphatidyl ethanolamine and phosphatidylinositol [30, 32]. Fatty acids like myristic acid, palmitic acid, stearic acid, arachidic acid, oleic, linoleic acid and linolenic [28].

Stem: It contains two iso flavones: prunetin and 5-methoxy genestein along with lupenone and lupeol and stigmasterol, stigmasterol- β -D-glucopyranoside and nonacosanoic acid [33]. Flavonoid 8-C-prenylquercetin 7,4'-di-O-methyl-3-O- α -L-rhamnopyranosyl-(1-4)- α -L-rhamnopyranoside [34], 3-hydroxy-9-methoxypterocarpan [(-)-medicarpin]. In addition to stigmasterol-3- α -L-arabinopyranoside, four compounds isolated from the stem of *Butea monosperma* have been characterized as 3-methoxy-8,9-methylenedioxypterocarp-6-ene, 21-methylene-22-hydroxy-24-oxooctacosanoic acid Me ester, 4-pentacosanylphenol and pentacosanyl- β -D-glucopyranoside [31].

Resins: The resins contain Z-amyrin, e-sitosterone glucoside and sucrose, lactone-nheneicosanoic acid-delta-lactone, laccijalaric esters I, II (Terpenic lac acid), jalaric esters I, II [36, 37].

Roots: Plant's root contains glucose, glycine and an aromatic hydroxy compound [38].



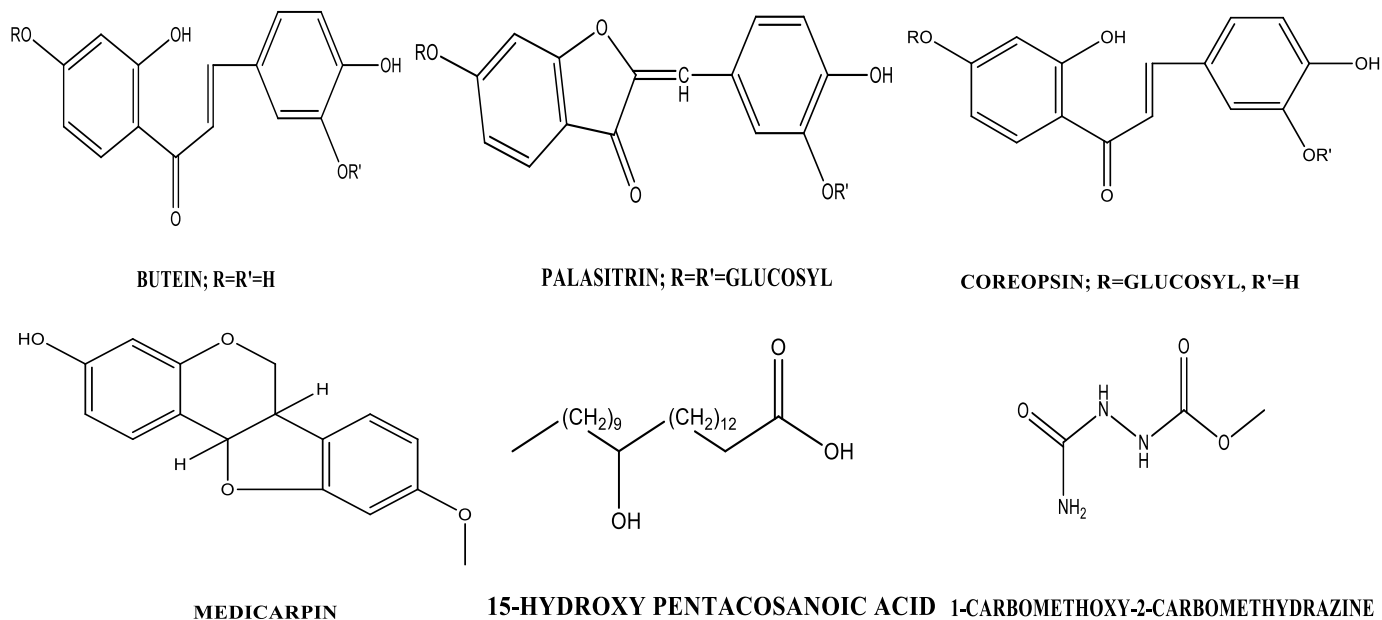


Fig 3: Showing structures of few phytoconstituents isolated from *Butea monosperma*

Pharmacological activities of *Butea monosperma*

Anti hyperglycemic Activity

The ethanolic extract of *Butea monosperma* was studied in glucose-loaded and alloxan-induced diabetic rats for anti hyperglycemic activity^[39]. Single dose treatment of extract (200 mg/kg, p.o.) significantly improved glucose tolerance and caused decrease in blood glucose level in alloxan-induced diabetic rats. Repeated oral treatment with *Butea monosperma* (200 mg/kg/day) for 2 weeks exhibited reduced blood glucose, serum cholesterol and improved HDL-cholesterol and albumin as compared to diabetic control group^[40].

Hepatoprotective Activity

The study was carried out to evaluate the effect of extract of *Butea monosperma* on the tumor promotion related events of carcinogenesis in rat liver. Thioacetamide (TAA) was used to trigger tumor promotion response and oxidative stress and caused significant depletion in the detoxification and antioxidant enzyme armory with concomitant increase in malondialdehyde (MDA) formation, hydrogen peroxide (H₂O₂) generation, ornithine decarboxylase (ODC) activity and unscheduled DNA synthesis^[41]. The alcoholic extract of *B. monosperma* used in the study seems to contribute dose-dependent protection and maintain the structural integrity of hepatic cells. This was evident from the significant depletion in TAA-induced serum GOT, GPT, Lactate dehydrogenase (LDH) and α -Glutamyl transpeptidase activity (GGT) activities ($p < 0.001$). The alcoholic extract possesses hepatoprotective effects and also it might suppress the promotion stage via inhibition of oxidative stress and polyamine biosynthetic pathway^[42].

Antiesterogenic and antifertility activity

The methanolic extract of flowers of the title plant has also been reported to exhibit antiestrogenic and antifertility activities¹. The active constituent Butin isolated from its flowers show both male and female contraceptive properties

^[43]. It has been reported to exhibit effect on uterotrophic and uterine peroxidase activities in ovariectomized rats & determine estrogenic/antiestrogenic potential of antifertility substances using rat uterine peroxidase assay^[44].

Radical scavenging activity

Evaluation for radical scavenging activity of various extracts such as ethyl acetate, butanol and aqueous fractions derived from total methanol extract of *Butea monosperma* flowers using different in vitro models like reducing power assay^[45]. Scavenging of 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical, nitric oxide radical, superoxide anion radical, hydroxyl radical and inhibition of erythrocyte hemolysis using 2, 2'-azo-bis (amidinopropane) dihydrochloride (AAPH). Methanolic extract along with its ethyl acetate and butanol fractions showed potent free radical scavenging activity. The observed activity could be due to higher phenolic contents in the extracts^[46].

Antitumor activity

The aqueous extract of flowers of *Butea monosperma* was administered via intraperitoneal route to the X-15-myc onco mice showed antitumorigenic activity by maintaining liver architecture and nuclear morphometry but also down regulated the serum VEGF levels. Immuno-histochemical staining of liver sections with anti-ribosomal protein S27a antibody showed post-treatment termination of this proliferation marker from the tumor tissue^[47].

Wound healing Activity

The efficacy of topical administration of an alcoholic bark extract of *Butea monosperma* on cutaneous wound healing in rats. Full thickness excision wounds were made on the back of rat and *B. monosperma* extract was dispensed topically. The granulation tissue formed on days 4, 8, 12 and 16 (post-wound) was used to estimate total collagen, hexosamine, protein, DNA and uronic acid^[48]. The extract elevated cellular

proliferation and collagen synthesis at the wound site, as evidenced by increase in DNA, total protein and total collagen content of granulation tissues. It also possesses antioxidant properties, by its ability to reduce lipid per oxidation. The results clearly substantiate the beneficial effects of the topical application of *B. monosperma* in the acceleration of wound healing^[49].

Anticonvulsive activity

The anticonvulsive activity is due to the presence of a triterpene^[50]. The petroleum ether extract of flowers of *Butea monosperma* exhibited anticonvulsant activity. The acetone soluble fraction of petroleum ether extract of *Butea monosperma* flowers exhibited anticonvulsant activity. The fractions protected animals from maximum electro shock, electrical kindling and pentylenetetrazol-induced convulsions in mice^[51]. However, they failed to protect animals from strychnine-induced convulsions. The fractions antagonized the behavioral effects of -amphetamine and potentiated the pentobarbitone-induced sleep. The fractions raised brain contents of gamma-aminobutyric acid (GABA) and serotonin^[41].

Thyroid inhibitory and hypoglycemic effects

Stigmasterol, isolated from the bark of *Butea monosperma* was examined for its thyroid hormone and glucose regulatory efficacy^[49]. The mice was administered with 2.6 mg/kg/d for 20 days which decreased serum tri iodothyronine (T3), thyroxin (T4) and glucose concentrations as well as the activity of hepatic glucose-6-phosphatase (G-6-Pase) with a concomitant rise in insulin level exhibiting its thyroid inhibiting and hypoglycemic properties^[52].

Anti-inflammatory activity

The leaves of *Butea monosperma* showed ocular anti-inflammatory activity in rabbits. The anti-inflammatory activity of methanolic extract of *Butea monosperma* evaluated by carrageenin induced paw edema and cotton pellet granuloma^[53]. In carrageenin induced paw edema at 600 and 800 mg/kg inhibition of paw edema, by 26 and 35% and in cotton pellet granuloma suppression of granuloma tissue formation, by 22 and 28%^[30, 54].

Antifungal activity

The ethyl acetate and petroleum extracts of stem bark of *Butea monosperma* showed antifungal activity against *Cladosporium cladosporioides*. An active constituent (-)-medicarpin is responsible for the antifungal activity. The seed oil of *Butea monosperma* also showed significant bactericidal and fungicidal effect in in-vitro testing^[30, 54].

Diarrhea

Butea monosperma gum has also been found to be of great use in cases of chronic diarrhea. It is a strong astringent and also lowers bilirubin level^[55]. The ethanolic extract of stem bark of *Butea monosperma* at 400 mg/kg and 800mg/kg inhibited castor oil induced diarrhea due to inhibiting gastrointestinal motility and PGE₂ induced enteropooling. It is used as nonspecific anti-diarrheal agent in folk medicine^[56].

Anthelmintic activity

The seeds of the plant possess the anthelmintic activity. It eliminates the parasitic worms from the Gastro-intestinal tract. Seeds of *Butea monosperma* extract when tested in vitro, showed the anthelmintic activity. Crude powder of Palash seeds given at the doses of 1, 2, 3 g/kg to sheep with mixed species of gastro-intestinal nematodes or round worms; it showed a dose and time dependent anthelmintic activity^[57, 58].

Hemagglutinating activity

The lectins such as *Butea monosperma* agglutinin (BMA) isolated from the seeds of *Butea monosperma* showing specificity towards human erythrocytes are responsible for agglutinating property; this property was only shown by seeds. Human blood group-A-specific agglutinins have been displayed in some of the N-acetyl galactosamine/galactose-binding lectins, such as the lectins. Hemagglutination test showed that N-acetyl galactosamine is the strongest inhibitor of agglutination^[59].

Anti-stress Activity

The ethanolic extract of the part of *Butea monosperma* that is water soluble was found to be useful in reducing the water immersion stress induced high concentration of serotonin and plasma cortico-steroidal hormone^[60].

Conclusion

Herbal medicines are the natural remedies which are used to recover the alterations made in normal physiological functioning of the body by foreign organisms. The traditional health care system, which is culturally patterned, in rural communities, seems to be the first and foremost line of defense. It is necessary to have a proper documentation of medicinal plants and to know their potential for the betterment of health and hygiene through an eco friendly system. Therefore; priority should be given to the potentiality of ethnomedicinal studies. The present overview unveils the plant. The plant *Butea monosperma* is a deciduous plant which has been introduced to tropical regions of the world as an ornamental. In several of these regions, the species is widely naturalized and regarded as invasive. It forms dense stands in dry and disturbed areas. Palash is rich in flavonoids, alkaloids, triterpenes, glycosides, steroids and lipids. The flower contains flavanoids which are very active and have sparked the interest of scientists. It demonstrated in clinical research to possess anti-hyperglycemic, hepatoprotective, anti-convulsive, anti-tumor, cancer preventative, and anti microbial actions. The further studies should be done to evaluate its chemical and pharmacological activity. It has an effective natural origin that has a tremendous future for research.

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