

A Multipurpose Medicinal Tree *Butea Monosperma*

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Abstract

The traditional systems of medicine together continue to play a significant role in our health care system for the betterment of mankind. *Butea monosperma* (Lam.) kuntze is a commonly used herb in Ayurvedic medicine. *Butea monosperma* (Palas) belongs to the family Fabaceae, grown wild in many parts of India. The plant is highly used by the rural and tribal people in curing various disorders. *Butea monosperma* has effective natural origin that has a tremendous future for research. *This is a moderate sized* deciduous tree which is widely distributed throughout India, known as 'dhak' or 'palas', commonly known as 'Flame of forest'. It finds use both medicinally and commercially with each part of the plant having utility. This plant has been found to wide variety of pharmacological activities. The plant is traditionally reported to possess astringent, bitter, aphrodisiac, anthelmintic, antibacterial and anti-asthmatic properties. It is powerful astringent and is given in many forms of chronic diarrhoea. Seeds have anthelmintic property especially for roundworms and tapeworms. Flowers yields a brilliant yellow coloring matter due to presence chalcones. Such herbal medicines may provide potential with less or no side effects.

Key Words: *Butea monosperma*, Palas, Pharmacology, Traditional uses.

Introduction

Scientific Classification

Kingdom- Plantae – Plants
Sub-kingdom- Tracheobionta – Vascular plants
Super-division- Spermatophyta – Seed plants
Division- Magnoliophyta – Flowering plants
Class- Magnoliopsida – Dicotyledons
Subclass- Rosidae
Order- Fabales
Family- Fabaceae – (papilionaceous)
Genus- *Butea* Roxb.ex Wild. – *Butea*
Species- *Monosperma* (Lam.) Taubert

Species of *Butea Monosperma*

Butea acuminata, *Butea Africana*, *Butea balansae*, *Butea bracteolata*, *Butea cuneiformis*, *Butea affinis*, *olia*, *Butea affinis*, *Butea dubia*, *Butea ferruginous*, *Butea gyrocarpa*, *Butea harmandii*, *Butea laotica*, *Butea listeri*, *Butea littoralis*, *Butea loureirii*, *Butea macroptera*, *Butea maingayi*, *Butea apoensis*, *Butea minor*, *Butea parviflora*, *Butea pellita*, *Butea peltata*, *Butea philippinensis*, *Butea braamiana*, *Butea oblong folia*, *Butea potting*, *Butea pulchra*, *Butea purpurea*, *Butea ridleyi*, *Butea riparia*, *Butea rosea*, *Butea sanguinea*, *Butea sericophylla*, *Butea spirei*, *Butea squirmier*, *Butea suberecta*, *Butea superba*, *Butea varians*, *Butea volubilis*, *Butea merguensis*.

Chemical Constituents

Flower - Triterpene, flavonoids butein, butin, Isobutrin, coreopsin, isocoreopsin, sulphurein, monospermoside and isomonospermoside, chalcones, auronones, isobutyne, palasitrin, 3',4',7- trihydroxyflavone. Stearic, palmitic, arachidic and lignoceric acids, glucose, fructose, histidine, aspartic acid, alanine and phenylalanine, pyrocatechin, Gum, tannins and mucilaginous material.

Seed- contains proteolytic and lypolytic enzymes, plant proteinase and polypeptidase. (Similar to yeast tripsin). A nitrogenous acidic compound, along with Palasonin is present in seeds. It also contains monospermoside (butein3-e-D-glucoside) and somonospermoside. Butin, α -Amyrin, β - sitosterol, β -sitosterol- β -D-glucoside, sucrose, Fatty acids such as myristic, palmitic, stearic, arachidic, behenic, lignoceric, oleic, linoleic and linolenic and Monospermin.

Root- The root of *Butea monosperma* contains glucose, glycine, a glycoside (aglycone) and an aromatic hydroxy compound.

Stem- In addition to stigmasterol-3- α -L- arabin pyranoside, 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.

Bark - Kino-tannic acid, Gallic acid, pyrocatechin. Also contains palasitrin, and major glycosides as butrin, alanine, allophanic acid, butolic acid, cyanidin, histidine, lupenone, lupeol, (-)-medicarpin, miroestrol, palasimide and shellolic acid (4, 53, 34, 16, 17, 18, 19, 20). Two compounds, 3, 9-dimethoxypterocarpan, and triterpenoid ester, 3 α - hydroxyeuph-25-enyl heptacosanoate.

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Leaves -Glucoside, Kino-oil containing oleic and linoleic acid, palmitic and lignoceric acid. Resin - Jalaric esters I, II and laccijalaric esters III, IV. Z-amyrin, e-sitosterone and its glucoside, sucrose, lactone-nheneicosanoic acid-lactone (51, 52) Sap - Chalcones, butein, butin, colourless isomeric flavanone and its glucosides, butrin.

Traditional Uses

Flower- *B. monosperma* is traditionally used as antioxidant, memory and behaviour stimulant, antileprotic, anticonvulsant, anti-inflammatory, antigout, antiulcer, antistress, astringent diuretic, antihepatotoxic, menstrual disturbances, enlarged spleen, burning sensation and eye diseases.

Leaf- *B. monosperma* is traditionally used as antitumor, anti-inflammatory, antidiabetic, antimicrobial, diuretic, anthelmintic, appetizer, astringent carminative, aphrodisiac, stomach disorders, diabetic sore throat, irregular bleeding during menstruation, flatulent colic, cough and cold.

Stem- bark is traditionally used as aphrodisiac, antidyenteric, antiulcer, antitumor, antimicrobial, antifungal, antipyretic, blood purifier and anti-asthmatic. It is also used in bleeding hemorrhoid disorder, dysmenorrheal, liver disorders, gonorrhoea, wound, worm infections, cough and cold.

Root- is used in night blindness, elephantiasis, impotency and in snake bite. It also causes temporary sterility in women and is applied in sprue, piles, ulcers, tumors and dropsy.

Seed- of *B. monosperma* is used in inflammation, bleeding piles, urinary stones, skin and eye diseases, abdominal troubles, intestinal worms and tumour. When seeds are pounded with lemon juice and applied to the skin, they act as a rubefacient. Gum is used in stomatitis, corneal apacititis, ring worm, leucorrhoea, septic sore throat, excessive perspiration and diarrhea.

PHARMACOLOGICAL ACTIVITY

Anti-inflammatory Activity

The leaves of *Butea monosperma* exhibit ocular anti-inflammatory activity in rabbits. The anti-inflammatory activity of Methanolic extract of *Butea monosperma* evaluated by Carrageenan induced paw edema and cotten pellet granuloma. In Carrageenan induced paw edema at 600 and 800 mg/kg inhibition of paw edema, by 26 and 35% and in cotten pellet granuloma inhibition of granuloma tissue formation, by 22 and 28%.

Anthelmintic Activity

Palasonin a compound obtained from seeds of *Butea monosperma* has anthelmintic activity. Seeds administered as crude powder at doses of 1, 2 and 3 g/kg to sheep naturally infected with mixed species of gastrointestinal nematodes exhibited a dose and a time dependent anthelmintic effect. The maximum reduction of 78.4% in eggs per gram of feces was recorded on day 10

after treatment with 3 g/kg. Levamisole (7.5 mg/kg), a standard anthelmintic agent, exhibited 99.1% reduction in eggs per gram. The anthelmintic activity of different species of *Butea* has been reported against *Ascaridia galli*, *ascaris lumbricoides*, earthworms, *toxocara canis*, *oxyurids*, *dipylidium caninum* and taenia, methanol extract of *Butea monosperma* seeds showed significant anthelmintic activity.

Antidiabetic Activity

Single dose treatment Ethanolic extract of *Butea monosperma* of (200 mg/kg, p.o.) significantly improved glucose tolerance and caused reduction in blood glucose level in Alloxan-induced diabetic rats. Repeated oral treatment for 2 weeks significantly reduced blood glucose, serum cholesterol and improved HDL-cholesterol and albumin as compared to diabetic control group. Ethanolic extract of leaves also have antidiabetic and antioxidant potential in Alloxan-induced diabetic mice. Ethanolic extract of seeds (300mg/kg b.wt.) exhibited significant antidiabetic, hypolipidemic and antiperoxidative effects in non-insulin dependent diabetes mellitus rats. Aqueous extract significantly decreases blood glucose level both in normal ($p < 0.01$) and Alloxan induced diabetic ($p < 0.001$) mice at 2 and 5 hr respectively. However, the hypoglycemic effect is peaked at 90min and is not sustained as observed for the standard drug Metformin. The effect of *Butea monosperma* on blood glucose and lipid profiles in normal and diabetic human volunteers was evaluated which indicated a significant decrease ($P < 0.05$) in 2 h post-prandial blood glucose (mg/dl) on 21st day in the diabetic subgroups treated with 2 g and 3 g of powdered *Butea monosperma*. A significant decrease in total cholesterol (mg/dl) was observed in normal and diabetic subgroups on day 21st post treatment. Both normal and diabetic groups exhibited a significant decrease in total lipids on day 21st. This study indicates that *B. monosperma* (Lamk.)Taub might possess important hypoglycemic and hypolipidemic properties.

Anticonceptive Activity

Butin which is isolated from the seeds of *Butea monosperma* administered orally to adult female rats at the doses of 5, 10 and 20 mg/rat from day 1 to 5 of pregnancy showed anti-implantation activity in 40%, 70% and 90% of the treated animals, respectively. At lower doses, there was a dose-dependent termination of pregnancy and reduction in the number of implantation sites. In ovariectomized young female rats, the butin exhibited estrogenic activity at comparable anticonceptive doses, but was devoid of anti-estrogenic activity. Butin is a weak estrogen in that a significant uterotrophic effect was discerned evens at 1/20th the anticonceptive dose. It was reported that seed oil use as traditional sexual toner and contraceptive.

Haemagglutinating Activity

Seeds of *Butea monosperma* showing specificity towards human erythrocytes. The lectins such as *Butea monosperma* agglutinin (BMA) isolated from the seeds of *Butea monosperma* are responsible for agglutinating property; this property was only shown by seeds not by flowers, leaves, roots and stems. Human blood group-A-specific agglutinins have been demonstrated in some of the N-acetyl galactosamine/galactose-binding lectins, such as the lectins. Haemagglutination test showed that N-acetyl galactosamine is the strongest inhibitor of agglutination.

Antiestrogenic and Antifertility Activity

Methanolic extracts of *Butea monosperma* exhibited effect on uterotrophic and uterine peroxidase activities in ovariectomized rats & determine estrogenic/antiestrogenic potential of antifertility substances using rat uterine peroxidase assay. Alcoholic extract of flowers of the title plant has also been reported to exhibit antiestrogenic and antifertility activities. Butin isolated from its flowers show both male and female contraceptive properties.

Hepatoprotective Activity

Isobutrin and Butrin, the antihepatotoxic principles of flowers were reported and this activity was monitored by means of CCl₄ and GalN-induced liver lesion *in-vitro*. The methanolic extract of *B. monosperma* possesses hepatoprotective effects and also it might suppress the promotion stage via inhibition of oxidative stress and polyamine biosynthetic pathway by significant reduction in Thioacetamide-induced serum Aspartate transaminase (AST/SGOT), Alanine transaminase (ALT/SGPT), Lactate dehydrogenase (LDH) and gamma-Glutamyl transpeptidase (GGT) activities.

Radical Scavenging Activities

Ethyl acetate, Butanol and aqueous fractions derived from total methanol extract of *Butea monosperma* flowers were evaluated for radical scavenging activities using different *in vitro* models like reducing power assay, 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). Methanol extract along with its ethyl acetate and butanol fractions showed potent free radical scavenging activity, whereas aqueous fraction was found to be devoid of any radical scavenging properties. The observed activity could be due to the higher phenolic content in the extracts (16.1, 25.29, and 17.74% w/w in methanol extract, ethyl acetate and butanol fractions respectively).

Antitumor Activity

Intraperitoneal administration of the aqueous extract of flowers of *Butea monosperma* in the X-15-myconco 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 abolition of this proliferation marker from the tumor tissue.

Thyroid inhibitory, Antiperoxidative and Hypoglycemic Effects

Stigmasterol, isolated from the bark of *Butea monosperma* was evaluated for its thyroid hormone and glucose regulatory efficacy in mice by administrating 2.6 mg/kg/d for 20 days which reduced serum triiodothyronine (T₃), thyroxin (T₄) and glucose concentrations as well as the activity of hepatic glucose-6-phosphatase (G-6-Pase) with a concomitant increase in insulin indicating its thyroid inhibiting and hypoglycemic properties. A decrease in the hepatic lipid peroxidation (LPO) and an increase in the activities of catalase (CAT), superoxide dismutase (SOD) and glutathione (GSH) suggested its antioxidative potential. The highest concentration tested (5.2 mg/kg) evoked pro-oxidative activity.

Wound Healing

Topical administration of an alcoholic bark extract of *Butea monosperma* on cutaneous wound healing in rats increased cellular proliferation and collagen synthesis at the wound site, by increase in DNA, total protein and total collagen content of granulation tissues, the tensile strength also increased significantly & histopathological examinations also provide favorable result. So, it possesses antioxidant properties, by its ability to reduce lipid peroxidation.

Antistress Activity

Water soluble part of ethanolic extract of flower attenuated water immersion stress, induced elevation of brain serotonin and plasma corticosterone levels. The ulcer index also decreased in dose dependent manner. Observed effects may be attributed to its nonspecific antistress activity.

Antimicrobial, Antifungal Activity

Antifungal compound isolated from petroleum and ethyl acetate extract of stem bark from *Butea monosperma* which were identified as (-)-3-hydroxy-9-methoxypterocarpan (-)-medicarpin. Both (-)-medicarpin and its acetate were active against *Cladosporium cladosporioides*. The active constituent of low polarity was isolated by bioassay monitored chromatographic fractionation, and identified as (-)-medicarpin by comparison of physical data. The antifungal activity of (-)-medicarpin was found to be greater than that of Benlate, a standard fungicide, while (-)-medicarpin acetate also exhibited significant activity against *C. cladosporioides*. The seed oil of *Butea monosperma* shows significant bactericidal and fungicidal effect in *in-vitro* testing studied by the filter paper disk method against several human pathogenic bacteria and fungi. Gum of *Butea monosperma* is used to treat microbial and fungal

infections in folk medicine. To validate this use, the in-vitro antimicrobial activity of petroleum ether and alcoholic extract of gum was evaluated against various microbial strains such as Staphylococcus.

Giardiasis

Giardiasis is a common gastrointestinal infection caused by a protozoal parasite, *Giardia lamblia*. Pippali rasayana (PR), an Ayurvedic herbal medicine, prepared from *Piper longum* (Pippali) and *Butea monosperma* (Palash) in which ash of stem, root, flower and leaves of *Butea monosperma* is used, has significant activity against Giardiasis. It produced up to 98% recovery from the infection. The rasayana had no killing effect on the parasite in vitro. It induced significant activation of macrophages as evidenced by increased macrophage migration index (MMI) and phagocytic activity. With higher doses of PR recovery increased up to 98% at 900 mg/kg.

Chemopreventive

Butea monosperma extract exhibited chemopreventive effects on hepatic carcinogenesis and on tumor promoter induced markers and oxidative stress in male Wistar rats. Treatment of male Wistar rats for five consecutive days with 2-AAF (2-acetylaminofluorine) i.p. induced significant hepatic toxicity, oxidative stress and hyper proliferation. Pretreatment of *B.monosperma* extract (100 and 200 mg/kg body weight) prevented oxidative stress by restoring the levels of antioxidant enzymes and also prevented toxicity at both doses. The promotion parameters induced (ornithine decarboxylase activity and DNA synthesis) by 2-AAF administration in diet with partial hepatectomy (PH) were also significantly suppressed dose dependently by *B. monosperma*. Thereafter, we proceeded with studies on rat liver carcinogenesis. After fourteen days of DEN (diethyl nitrosamines) treatment, dietary administration of 2-AAF with PH resulted in a 100% incidence of tumors in the animals. However, *B.monosperma* caused reduction in the number of tumors/ rat and percentage of tumor bearing rats at the end of the study, as confirmed histologically. Thus, their data suggests that *B.monosperma* extract is a potent chemopreventive agent which suppresses 2-AAF-induced hepatic carcinogenesis and oxidative damage in Wistar rats. The protective activity of the plant might be due to the two major constituents (butrin and Isobutrin).

Anti-diarrhoeal Activity

Ethanol extract of stem bark of *Butea monosperma* (Lam) Kuntz at 400 mg/kg and 800mg/kg inhibited castor oil induced diarrhoea due to inhibiting gastrointestinal motility and PGE2 induced enter pooling and it also reduced gastrointestinal motility after charcoal meal administration in Wistar albino rats. *Butea monosperma* gum has also been found useful in cases of chronic diarrhoea. It is a powerful astringent and also decreases bilirubin level.

Results and Discussion

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Butea monosperma (Palas) Tree and flowers