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AN OVERVIEW OF *BUTEA MONOSPERMA*: MORPHOLOGY, PHYTOCHEMICAL ANALYSIS, CHEMISTRY AND PHARMACOLOGICAL ACTIVITIES

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ABSTRACT

Butea monosperma, a member of the Fabaceae family also known as "palas" and "Flame of forest," is one of several natural crude medications used in traditional medicine that can treat a variety of diseases and ailments. It is an herb that has long been used voluntarily traditional Asian treatments. Many phytochemicals primarily flavonoids, alkaloids, Tannins, Saponin, Phenol, Proteins, Carbohydrates and glycosides are present in the plant's aerial portion. It has been used to treat a variety of illnesses, including diabetes, cancer, diarrhoea, dysentery, fever, and jaundice. Pharmacologically *Butea monosperma* has been linked to a number of effects including anthelmintic, anticonvulsant, anti-diabetic, anti-diarrheal, anti-estrogenic, anti-fertility, anti-inflammatory, anti-microbial, anti-fungal, anti-bacterial, anti-stress and wound healing properties. The current review goes into great detail into the morphology, phytochemical components and traditional uses of plant as well as the pharmacological functions of plant.

KEYWORDS: *Butea monosperma*, palas, Flame of forest, phytochemical analysis, Flavonoids, alkaloids, glucosides, Butein, Butin, Isobutein, anthelmintic, anti-diabetic, anti-diarrheal, anti-inflammatory, anti-fungal.

INTRODUCTION

Medicinal plants have been accumulated in the course of many centuries based on different medicinal system such as Ayurveda, Siddha and Unani. In India it is reported that traditional healers use 2500 plants species and 100 species of plants serve as regular source of medicinal preparation in the pharmaceutical industries. During the last few decades there has been an increasing interest in the study of medicinal plants and their traditional use in different use in different part of the world.[1]

In India, approximately 90% of plant materials are sourced from wild environments. Many of these plants have become rare, threatened, endangered, or vulnerable as a result of unsustainable harvesting practices. The ethno-botanical survey reveals that approximately 8,000 species of medicinal plants are utilized by various tribal communities for traditional medicinal preparations. Approximately 427 ethnic communities and folk healers utilize around 8000 species of medicinal plants across various regions of India.[1]

According to World Health Organization (WHO), the primary health care of 70-95% of the population in the developing countries is based on traditional medicine while in developed countries like Germany and Canada, 80% and 70% of the population respectively have used complementary and alternative medicine at least once. Medicinal product from plants or other natural sources have taken a very large share of the healthcare market. The dependence and reliability on the herbal drugs is increasing rapidly and is growing popular.[1]

Butea monosperma, commonly referred to as Flame of the Forest, is a member of the Fabaceae family. Butea monosperma (Lam.) Taub., commonly referred to as the flame of the forest or palash, is a significant deciduous tree species found in the Indian subcontinent. It is extensively found in the tropical and subtropical areas of India, Nepal, Sri Lanka, and Bangladesh, playing an essential role in dry deciduous forests. The tree is highly regarded for its various applications, encompassing its striking flowers, edible gum, seeds, and robust timber.

The components are integral to the local economy and traditional medicine, particularly within rural communities.[2,3]

BOTANICAL DESCRIPTION OF BUTEA MONOSPERMA

It is an upright, 12- to 15-meter-tall tree with a crooked trunk and uneven branches. Silky pubescence in shades of grey or brown covers the shoots. Ash-coloured bark can be seen. The three foliate, big, and stipulate leaves. Petiole length is 10 to 15 cm. The bases of the leaflets are deltoid, and they are obtuse, glabrous above, delicately silky, and prominently reticulately veined beneath. The plant has bald patches from January through March. Flowers grow in 15 cm long, stiff racemes that are heavily covered in brown velvet. Calyx has a highly velvety exterior and is dark, olive green to brown in colour. The corolla is lengthy and has bright orange red and silky silvery hairs on the outside.[4]

Butea, with each vegetative part, has unique chemical components and medicinal significance. Three leaflets, ranging in shape. The leaves range in size from 15 to 20 cm across and 10 to 15 cm long. The leaves are shed in winter and reappear in spring. From February through the end of April, this plant begins to bloom. The seeds are flat, measuring 25–40 mm in length, 15–25 mm in width, and 2 mm in thickness. The seed has a wrinkled reddish brown seed coat and two creamy yellow cotyledons. Long, sideways roots cover the dense root tip. When fibers are injected into the plant, the bark's color changes from gray to light brown and leaks a cherry-red extract that is known as resin.[5]

The palas fruit is a flat legume that resembles a pod and measures about 15 cm in length and 3 to 5 cm in width. Young pods have a lot of hair and a velvety covering. The pods droop like odd legumes when they are ripe. The wood has a greenish white color. It has a soft texture, is porous, and has annual rings, though they are not very noticeable. It frequently deteriorates rapidly when used in areas where weather patterns fluctuate, but it lasts a lot longer when used underwater. As a result, it is used to make efficient piles and curbs.[6]

OTHER NAME[1]

LANGUAGES	SYNONYMS
English	Flame of the forest, Bastard teak, Bastard Teak, Parrot Tree
Hindi	Dhak, Palas, Chichra tesu, desukajhad, dhak, chalcha, kankrei
Kannada	Muttagamara
Malayalam	Plasu Camata, Muriku, Shamata
Sanskrit	Palasah
Tamil	Porasum, Parasu, Camata
Telugu	Modugu
Gujrat	Khakda
Bangal	Palas, Polashi
Urdu	Palashpapra

BOTANICAL CLASSIFICATION[7]

Kindom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	Butea
Species	Monosperma

PHYTOCHEMICAL ANALYSIS OF PLANT EXTRACT

Test for alkaloids

1 ml of the extract was stirred with 5 ml of 1% aqueous HCl on a steam bath and filtered while hot. 1 ml of the filtrate was treated with a few drops of either Mayer's reagent (potassium mercuric iodide solution), Wagner's reagent (iodine in potassium iodide solution), or

Dragendorff's reagent (potassium bismuth iodide solution) after distilled water was added to the residue. The formation of a cream colour with Mayer's reagent and reddish-brown precipitate with Wagner's and Dragendorff's reagent give a positive test for alkaloids.[1,8]

Test for Tannins

1 ml of extract (10% w/v) was combined with 3 ml of water, brought to a boil for 5 minutes, and then filtered. Further, 1 ml of 0.1% ferric chloride was added to 3ml filtrate and observed for the appearance of dark green color or blue- black color. This color's appearance suggests that tannins are present.[8]

Test of Flavonoids

5 ml of each extract were mixed with 3 ml of a 1% aluminum chloride solution. A yellow coloration was observed indicating the presence of flavonoids. 5ml of dilute ammonia solution was added to the above mixture followed by addition of concentrated H2SO4.By adding it, the yellow coloration disappears which indicates the presence of flavonoids, thus, indicating the test positive for flavonoids.[8]

Test for Saponin

In a water bath, about 5 ml of the extract were boiled in 20 ml of distilled water before being filtered. To create a stable, long-lasting froth, 10 ml of the filterate and 5 ml of distilled water were combined and vigorously shaken. After adding three drops of olive oil to the frothing and giving it a good shake, the presence of saponin was confirmed by looking for the formation of an emulsion.[8]

Test for Phenol

A 30 ml test tube was filled with 5 ml of the extract, 10 ml of distilled water, 2 ml of ammonium hydroxide solution, and 5 ml of concentrated amyl alcohol. The mixture was then allowed to react for 30 minutes. Phenols are present when a bluish green color develops, which makes the test positive.[8]

Test for Glycosides

To 1 ml of each extract, 0.5ml of glacial acetic acid and 3 drops of 1% aqueous ferric chloride solution were added, formation of brown ring at the interface indicates the presence of cardiac glycosides in the sample extract.[1,8]

Test for Proteins

To 2 ml of each extract, 1 ml of 40% sodium hydroxide and few drops of 1% copper sulphate were added; formation of violet colour indicates the presence of peptide linkage molecules in the sample extract.[8]

Test for Carbohydrates

Add a few drops of Molisch's reagent to 1 ml of the extract, and then add 1 ml of concentrated sulfuric acid to the side of the tubes. The mixture was then left to sit for 2 to 3 minutes, during which time a red or dull violet color appeared, showing that carbohydrates were present in the sample extract.[1,8]

CHEMICAL CONSTITUENTS OF *BUTEA MONOSPERMA*

Flavonoids[7,9]

Butein: A flavonoid with potent antioxidant and anti-inflammatory properties. It has been shown to inhibit oxidative stress and inflammation, contributing to the plant's therapeutic effects.

Butin: Another flavonoid that exhibits strong antioxidant activity. It also has potential anti-cancer and anti-inflammatory effects.

Isobutein: This substance has antioxidant qualities as well and could help lessen oxidative damage.

Saponins[9]

Butea saponins: These are glycosidic compounds that can exhibit expectorant, anti-inflammatory, and immune-modulatory effects. It has been observed that Butea monosperma saponins contribute to the plant's increased therapeutic potential.

Tannins[9]

Butea tannins: These polyphenolic substances can promote wound healing and are well-known for their astringent qualities. Tannins also exhibit antioxidant and antimicrobial activities, contributing to the plant's overall pharmacological profile.

Glycosides[9]

Cardiac Glycosides: These compounds, although present in minor quantities, can influence heart function.

They have been investigated for their potential benefits in cardiac health and their role in traditional medicine.

Essential Oils[9]

Volatile Oils: The essential oils from Butea monosperma contain various terpenes and sesquiterpenes, contributing to its aromatic properties and potential antimicrobial activities.

Alkaloids[9]

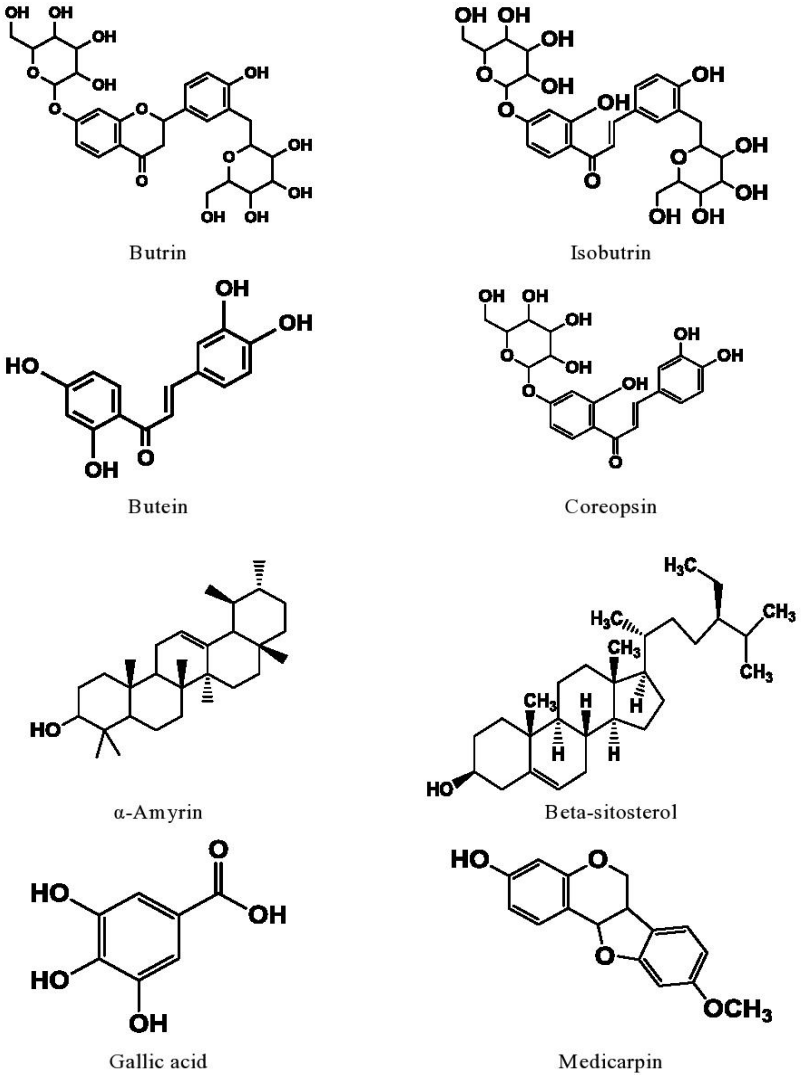
Butea alkaloids: Although less research has been done on them, they might be involved in the pharmacological effects of the plant. It has been demonstrated that certain alkaloids in related species have biological activity.

Other Compounds[9]

Polysaccharides: Present in the plant, polysaccharides may contribute to immunomodulatory effects.

Sterols: Substances such as β-sitosterol may be found and contribute to a number of biological activities, such as hypocholesterolemic and anti-inflammatory effects.

CHEMISTRY[11,12]



Chemical structure of the biologically active compounds of *Butea monosperma*.

PHARMACOLOGICAL ACTIVITIES

Anti-conceptive activity[13]

When adult female rats were given Butin—an extract from the seeds of Butea monosperma—orally from day 1 to day 5 of pregnancy at doses of 5, 10, or 20 mg per rat, the treatment prevented implantation in 40%, 70%, and 90% of the animals, respectively. Even at the lower doses, the number of implantation sites was reduced, and pregnancy loss increased in a dose-dependent manner. In young ovariectomized female rats, Butin also produced estrogen-like effects at doses similar to those that caused contraceptive activity, although it did not show any anti-estrogenic properties. It acts as a mild estrogen, since a strong uterine response occurred even at one-twentieth of the contraceptive dose. Traditionally, the seed oil has been used as a sexual tonic and as a natural contraceptive.

Anthelmintic activity[10,11,13]

Sheep infected with parasites were treated with Butea monosperma seed powder at different doses. The highest dose (3 g/kg) reduced worm eggs in feces by 78.4% after ten days. In comparison, the standard drug levamisole reduced them by 99.1%. Although some Butea species can be harmful to humans, Butea monosperma seed extracts—especially methanol extracts show strong anthelmintic effects against several parasites.

Anticonvulsant activity[10,13]

TBM is a triterpene identified in Palash and is believed to contribute to its anticonvulsant activity, though more studies are still needed to fully confirm this. Research so far shows that TBM can protect against seizures triggered by several models, including MES-induced seizures, PTZ, pilocarpine, lithium sulfate, and electrical shock. It also appears to produce CNS-depressant effects when used continuously for about seven days. Likewise, repeated TBM administration did not reduce the duration of pentobarbital-induced sleep.

Antidiabetic activity[9,10,11,13]

In rats with alloxan-induced diabetes, treatment with an ethanolic extract of Palash for 14 days led to repeated reductions in blood glucose levels. The extract also

lowered total serum cholesterol and increased HDL ("good") cholesterol when compared with diabetic control animals. Overall, the ethanolic extract showed antidiabetic, cholesterol-lowering, and antioxidant (antiperoxidative) effects in this type-2-diabetes model. The aqueous extract also reduced blood glucose in both healthy and alloxan-induced diabetic mice. Its strongest blood-sugar-lowering action occurred about 90 minutes after administration. However, its effect did not last as long as that of metformin.

Antistress activity[11,13]
Researchers found that the water-soluble part of the ethanolic extract of Butea monosperma helped reduce the rise in serotonin and plasma corticosteroid levels that occurs during water-immersion stress.

Anti Implantation activity[13]
Researchers found that butin, a compound isolated from the seeds of the Palash plant (Butea monosperma), can act as both a male and female contraceptive. When female rats were given butin at doses of 5, 10, or 20 mg per rat during the first five days of pregnancy, it prevented implantation in 40%, 70%, and 90% of the rats, respectively. Additionally, the alcoholic extract of Palash also showed antifertility effects. Butin behaves like a mild estrogen, because even at a dose about 20 times lower than the contraceptive dose, it still produced a noticeable effect on the uterus.

Anti Inflammatory activity[9,10,13]
Researchers tested the anti-inflammatory properties of a methanolic extract from Butea monosperma in albino rats with inflammation caused by carrageenan and by cotton-pellet–induced granulomas. From this extract, they identified an active compound called MEBM. When given orally at doses of 600 mg/kg and 800 mg/kg, MEBM significantly reduced paw swelling triggered by carrageenan. The same doses also lowered the amount of granuloma tissue formed around cotton pellets. In addition, MEBM reduced levels of serum lysosomal enzymes and lipid peroxides when compared with control animals.

Antifungal activity[10,13]
Cladosporium cladosporioide was found to be unaffected by the antifungal effects of Palash's petroleum and ethyl acetate extracts. The compound responsible for the antifungal activity was medicarpin, which showed stronger effectiveness than the widely used fungicide Benlate.

Anti – diarrheal activity[10,11,13]
Ethanolic extracts of Butea monosperma stem bark, given at doses of 400 mg/kg and 800 mg/kg, were found to counteract castor-oil–induced increases in gut movement in Wistar albino rats during charcoal meal tests. The extract also reduced PGE_2-triggered fluid accumulation in the intestines, which contributes to diarrhoea. Additionally, Butea monosperma gum has been reported to help with chronic diarrhoea because of its strong astringent effects, and it may also help lower bilirubin levels.

Antiesterogenic and antifertility activity[10,13]
Methanolic extracts of Butea monosperma were found to influence uterine growth and uterine peroxidase activity in rats that had their ovaries removed. The rat uterine peroxidase test was used to evaluate whether certain antifertility drugs act like estrogen or block its effects. Previous studies have shown that alcohol-based extracts of the plant's flowers have antiestrogenic and fertility-reducing effects. Additionally, a compound called butin, which can be isolated from the flowers, has been found to possess contraceptive effects in both males and females.

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