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Review Article

BUTEA MONOSPERMA (LAM.) KUNTZE: A REVIEW

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ABSTRACT
The traditional systems of medicine together with homoeopathy and folklore medicine continue to play a significant role largely in the health care system of the population. *Butea monosperma* (Palas) belonging to the family *leguminaceae* grown wildly in many parts of India. The plant is highly used by the rural and tribal people in curing various disorders. The present paper enumerates various traditional and medicinal utility of the plant and attempt was made to gather information about the chemical composition and pharmacological aspects of the plant.
KEYWORDS: *Butea monosperma*, Palas, Phytochemistry, Medicinal uses

INTRODUCTION

Butea monosperma (Palas) is a medium-sized deciduous tree belongs to family Leguminosae- Papilioneae. This tree is also called 'Flame of the Forest' and Bastard Teak. It is said that the tree is a form of Agnidev, God of Fire. It was a punishment given to him by Goddess Parvati for disturbing her and Lord Shiva's privacy[1]. It is a species of *Butea* native to tropical southern Asia, from Pakistan, India, Bangladesh, Nepal, Srilanka, Myanmar, Thialand, Laos, Cambodia, Vietnam, Malaysia and western Indonesia. It is a medium sized deciduous tree, trunk crooked and irregular branches and rough, very conspicuous during periods of flowering, 12-15m in height with gray flaky bark. The bark provides a gum. Leaves are alternate, spreading, large, pinnately trifoliate, long stalked and petiolate. Petiole slender, cylindrical, thickened at the base, downy when young. Stipules small, deciduous, linear-lanceolate. Leaflets are 3-8 inches long, coriaceous, margin entire, obtuse and glabrous above when old, finely silky and conspicuously veined underneath, lateral leaflets rhomboid, terminal leaflets ovate. Flowers are large, bright orange red and produced in rigid racemes. Flower buds appear in January and flaming scarlet or orange coloured blossoms appear during February-April, when the tree is leafless. Flowers are numerous, on twisted or pendulous stalk about ¾ inch long, arranged in threes on the sides of long rigid peduncles a foot long which come off from tuberosities on the wood, and forming very large racemose panicles and two very small ones immediately beneath the flowers. Fruits are pods with a single seed in each. Pods ripen in May-June. Fruit pods are velvety brown, base wing like. Pods 4-6 inches long, pendulous, shortly stalked, oblong, blunt, very much laterally compressed, flat, thickened at the sutures, leathery, thinly downy especially towards the end and on the margins, the lower ¾ indehiscent and with out seeds, the terminal ¼ containing a single seed and splitting along the edge.Seeds flat, very much compressed, brownish, about ¼ inch long, very broadly oval, smooth with a small hilum. The other vernacular names for Butea monosperma are Dhak, Palas, Chichra, Kakria, Kankeri, Tesu (Hindi), Flame of forest (English), Palasha, Bijasneha, Bramhapadapa, Kamalasana, Karaka, Kashtadru (Sanskrit), Khakra, Khakda, Khakhado, Palassoo (Gujarati), Nim, Palas (Bengali and Marathi), Mutthuga (Kannada), Palas in samatha, Chamatha, Kimshukam, Brahmavriksham (Malyalam), Parasu, Palashamaram, Puppa-lasu, Purasu, Sira, Tikkuru (Tamil), Moduga, Tellamoduga, Palasamu, Kimsukamu, Togarumo- duga (Telgu), Polas, Porasur (Oriya), Dhak, Palas, Chichra (Punjabi) Palashpapra (Urdu), Palasa (Tulu), Parasu (Singhalese)[2-6]. *B. monosperma* is a medium sized deciduous tree, with a somewhat crooked trunk (10-15 feet) in height and 5-6 feet in girth. This tree is common throughout the greater part of India and Burma, up to 3,000 feet and higher in the outer

Himalaya, Khandesh Akrani up to 3,700 feet, hills of S. India up to 4,000 feet, Ceylon. It also grows in the forests of Oudh and Bundelkhand, Chotanagpur, Central and Southern India[3, 7]. *Palasa* has been referred in *Brhatrayi* (three big compendia) of *Ayurveda by Caraka, Sustra and Vagbhata* approximately at 54 places, 42 places and 37 places respectively.

Scientific Classification

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Fabales
Family: *Fabaceae*
Genus: *B.monospermous*

Butea Species

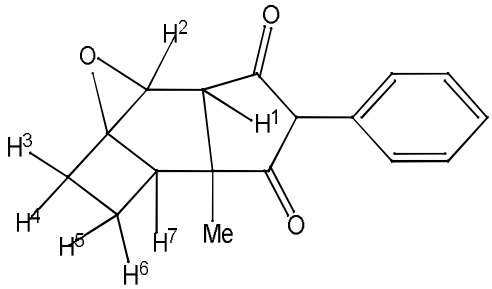
Butea acuminata, *Butea affinis*, *Butea Africana, Butea apoensis, Butea balansae*, *Butea braamiana, Butea bracteolate, Butea cuneiforms, Butea crass folia, Butea dubia*, *Butea ferruginous, Butea gyrocarpa*, *Butea harmandii*, *Butea laotica*, *Butea listeri*, *Butea littoralis*, *Butea loureirii*, *Butea macroptera*, *Butea maingayi*, *Butea merguensis*, *Butea minor, Butea oblong folia, Butea parviflora*, *Butea pellita*, *Butea peltata*, *Butea philippinensis*, *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.*

PHYTOCHEMISTRY

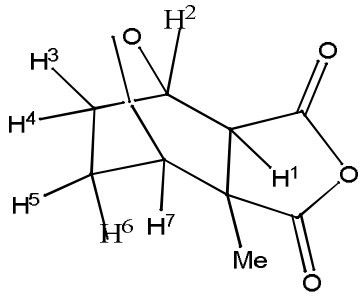
A number of constituents have been reported from the various species of *Butea* and they belong to imides, lactone, flavonoids, sterols and alkaloids.

Imide

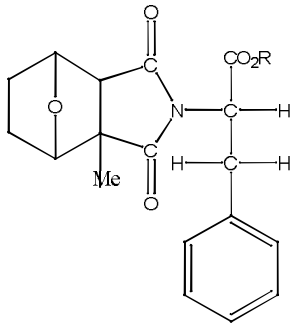
Palasimide (1) has been isolated from the pods of *B. monosperma* (Lam.) Kuntze and palasonin (2) from the seeds of *B. monosperma* along with nitrogenous acidic compound (3) and its methyl ester (4)[8-9].



(1) Palasimide



(2) Palasonin

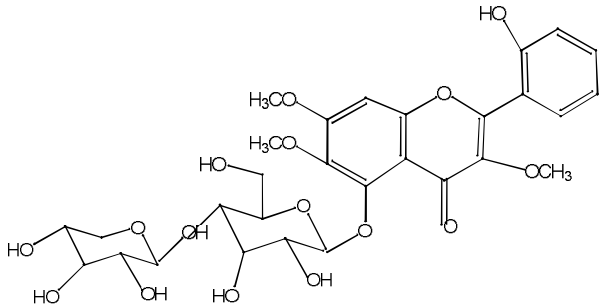


(3) R = H, Nitrogenous acidic compound
(4) R= Me, Methyl ester of nitrogenous acidic compound

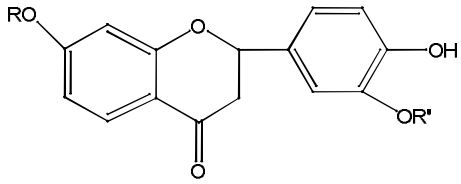
Flavonoids

A potential flavone glycoside isolated from the seeds of *B. monosperma O.* Kuntze has been identified as 5, 2′-dihydroxy-3,6,7-trimethoxy flavone -5-O-*β*-D-xylopyransyl-(1-4)-O-*β*-D-glyc- opyranoside (5). It possesses the antiviral activity[10]. Two flavonoids butrin (6) and isobutrin (7) have been isolated from the flower of *B. monosperma*. A flavone glycoside identified as 5,7-dihydroxy-3,6,4'trimethoxy flavone-7-O-*α*-L-xylopyranosyl-(1-3)-O-*α*-L-arabinopyranos-y1-(1-4)-O-*β*-D-galactopyranoside (8) have shown to posses the antifungal activity against *Aspergillus niger*, *Fusarium oxysporum*, *Tricoderma viride*, *Penicillium digitatum*[11]. A number of flavonoids and their glycosides have been isolated and identified from the flowers of *B. monosperma*. They include butin (9), butein (10), palsitrin (11), coreopsin (12), isocoreopsin (13) and sulphurein (14) monospermoside (15) and isomonospermoside (16). A flavone, quercetin (17) has been isolated from stem bark of *B. frondosa*[12]. Two

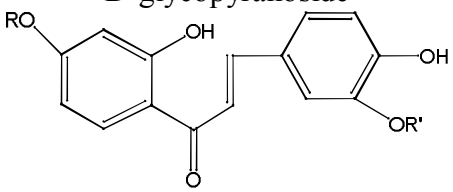
isoflavanoid isolated from the ethyl acetate extracts of *B. monosperma* stem bark have been identified as 5-methoxygenistein (18) and prunetin (19).



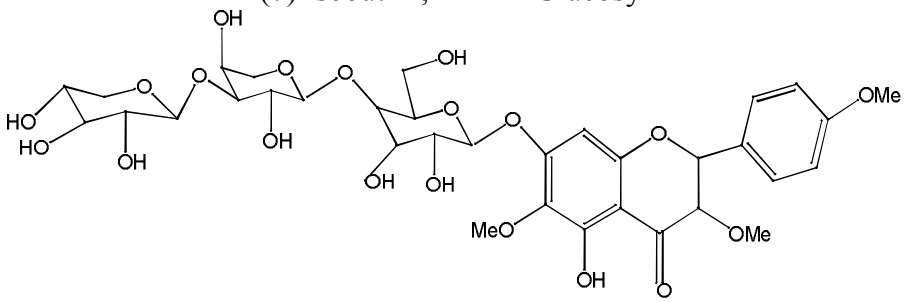
(5) 5,2'-dihydroxy-3,6,7-trimethoxyflavone



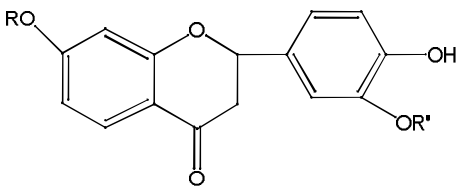
(6) Butrin; R=R'= Glucosyl -5-O-*β*-D-xylopyransyl-(1-4)-O-*β*-D-glycopyranoside



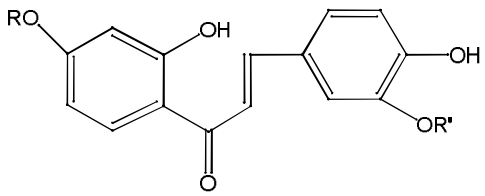
(7) Isobutrin; R=R'= Glucosyl



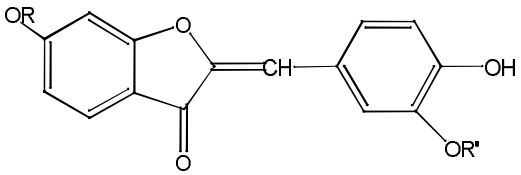
(8) 5,7-dihydroxy-3,6,4'trimethoxyflavone-7-O-*α*-L-xylopyranosyl-(1-3)-O-*α*-L-arabinopyranosyl-(1-4)-o-*β*-D-galactopyranoside



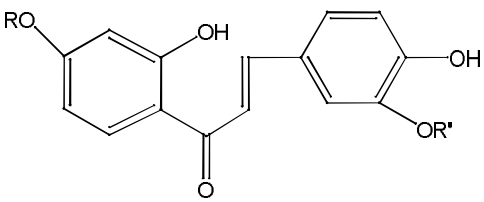
(9) Butin; R=R'= H



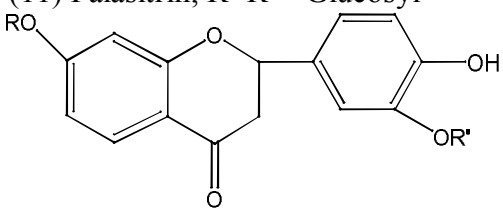
(10) Butein; R=R'= H

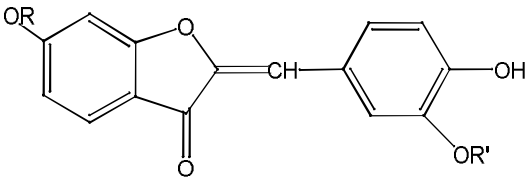


(11) Palasitrin; R=R'= Glucosyl

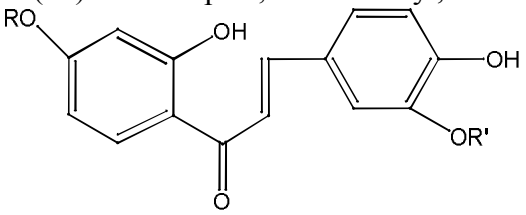


(12) Coreopsin; R= Glucosyl, R'= H

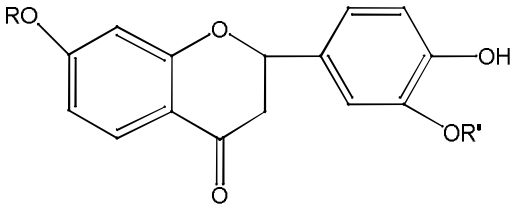




(13) Isocoreopsin; R= Glucosyl, R'= H

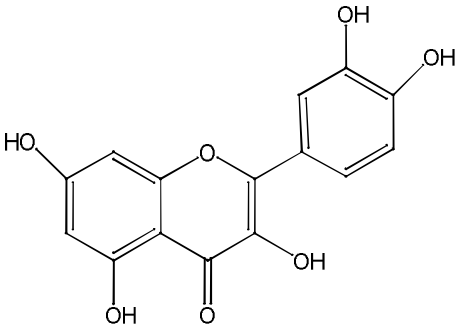


(14) Sulphurein; R= Glucosyl, R'= H

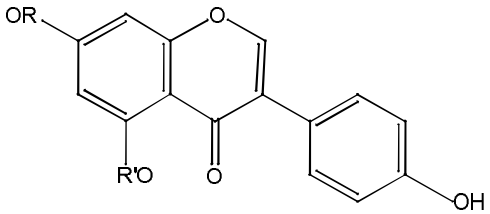


(15) Monospermoside; R= H, R'= Glucosyl

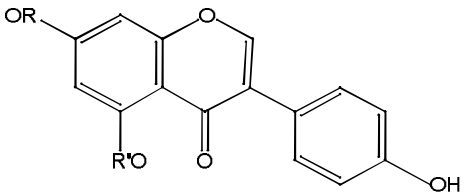
(16) Isomonospermoside; R= H, R'= Glucosyl



(17) Quercetin



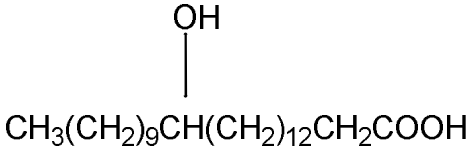
(18) 5-methoxygenistein; R=H, R'= CH_3



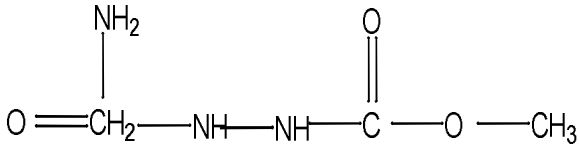
(19) Prunetein; R=CH_3, R'= H

Aliphatic Compounds

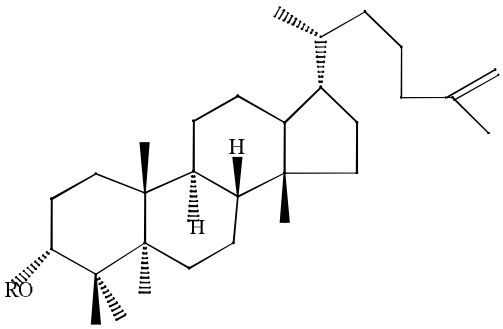
Two aliphatic long chain hydroxy acids and a derivative of hydrazine have been isolated from the ethanolic extract of *B. monosoerma* seed coat and identified as 15-hydroxy pentacosanoic acid (20) and 1-carbomethoxy-2-carbomethydrazine (21). Two aliphatic compounds identified as 3-*α*-hydroxy-euph-25-ene (22) and 2, 14-dihydroxy-11, 12-dimethyl-8-oxo-octadec-11-enylcyclohexane (23) have been isolated from the stem of *B. monosperma*[13]. Aliphatic compounds identified as 2-hydroxy-*ω*-a methyl allophanic acid (24) has been isolated from the seeds of *B. monosperma* (Lam.) Kuntze[24]. Nonacosanoic acid (25) has been isolated from the stem of *B. monosperma*[13].



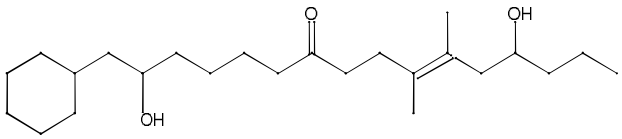
(20) 15-hydroxy pentacosanoic acid



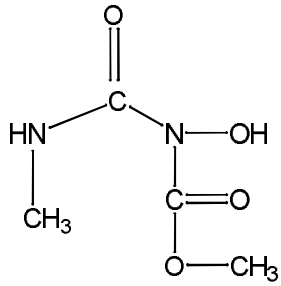
(21) 1-carbomethoxy-2-carbomethydrazine



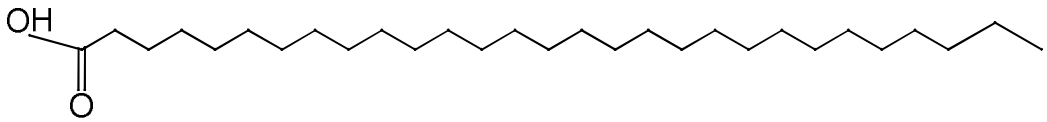
(22) 3-α-hydroxy-euph-25-ene



(23) 2,14-dihydroxy-11,12-dimethyl-8-oxo octadec-11-enylcyclohexane



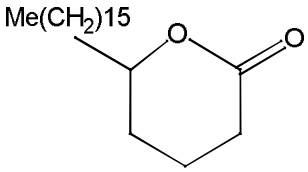
(24) 2-hydroxy-ω-methyl allophanic acids



(25) Nonacosanoic acid

Lactone

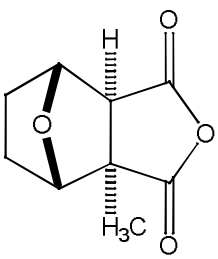
A δ-lactone of heneicosanoic (26) acid has been isolated from the seeds of *B. fronodosa*.



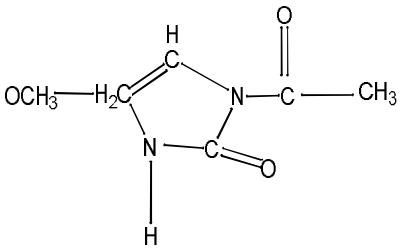
(26) δ-lactone of heneicosanoic

Alkaloids

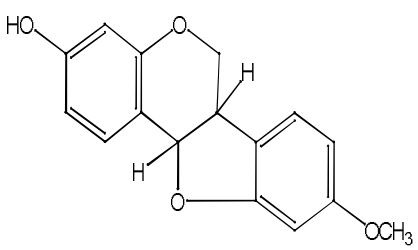
Palasonin (27) isolated from the seeds of *B. monosperma* have shown to possess anthelmintic activity. Monospermin has been isolated from *B. monosperma* seeds (28)[15]. Medicarpin (29) isolated from petroleum ether and ethyl acetate extract of the stem bark of *B. monosperma* has shown antifungal activity against *Cladosporium cladosporioides* .



(27) Palasonin



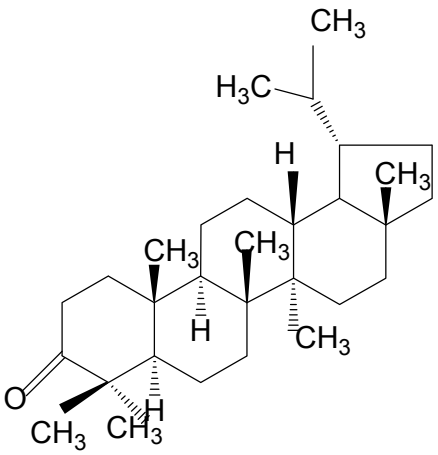
(28) Monospermin



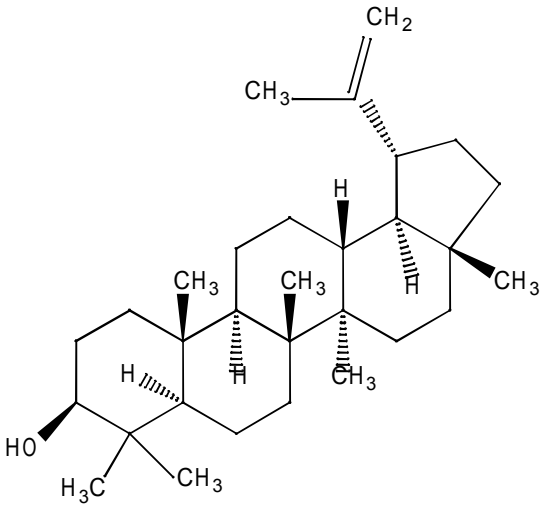
(29) Medicarpin

Sterols

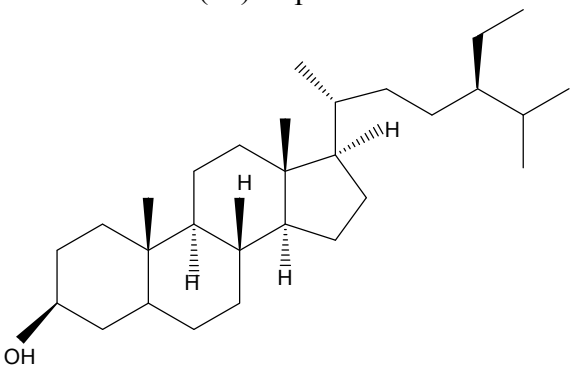
The petroleum ether extract of *B. monosperma* stem bark yielded Lupenone (30), lupeol (31) and *β* sitosterol (32). Three compounds identified as stigmasterol (33), stigmasterol- *β*-D-glucopyranoside (34) has been isolated from the stem of *B. monosperma*[13]. *β* –sitosterol (32) has also been isolated from the flowers and seeds of *B. monosperma* (Lamk.) Taub. Which possess estrogenic activity[16]. *β*-sitosterol-*β*-D-glucoside (35) has been isolated from the seeds of *B. frondosa*[16].



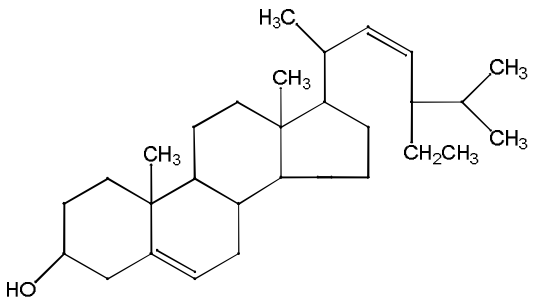
(30) Lupenone



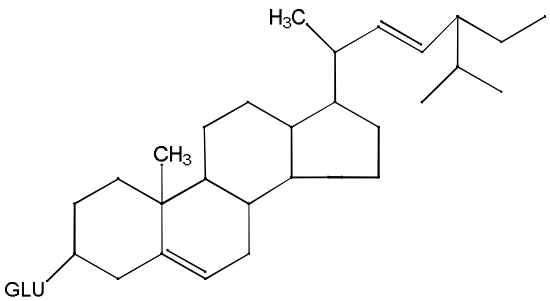
(31) Lupeol



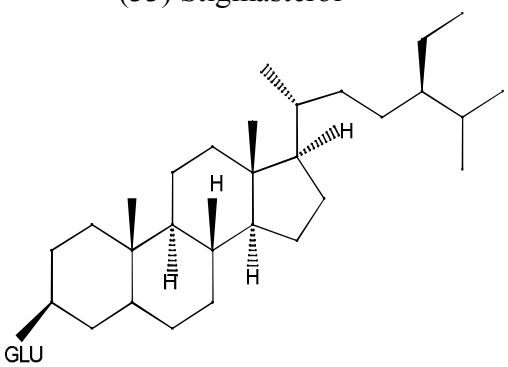
(32) *β*-Sitosterol



(33) Stigmasterol



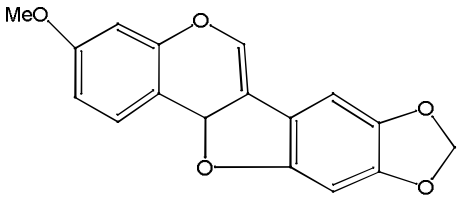
(34) Stigmasterol- *β*-D-glucopyranoside



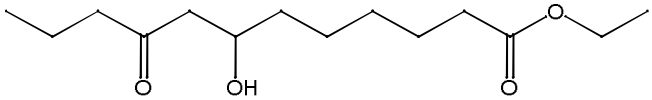
(35) *β*-sitosterol-*β*-D-glucoside

Miscellaneous

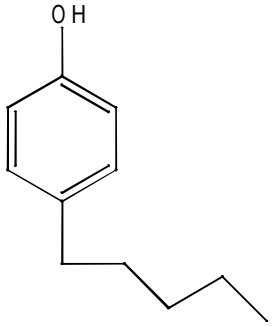
Four compounds identified as 3-methoxy-8,9-methylene dioxypterocarp-6-ene (36), 21-methylene-22-hydroxy-24-oxooctasanoic acid methyl ester (37), 4-pentacosanylphenol (38) and pentacosanyl- *β*-glucopyranoside (39) have been isolated from the stem of *B. monosperma*. *α*-amyrin (40) and sucrose (41) have been isolated from the seeds of *B. frondosa*[16]. Proanthocyanidin (43) has been isolated from the bark and gum of *B. monosperma*[31].



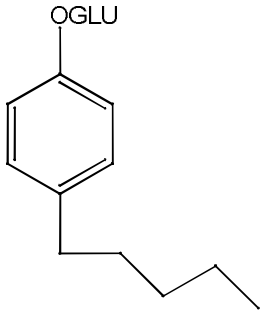
(36) 3-methoxy-8,9-methylene dioxypterocarp-6-ene



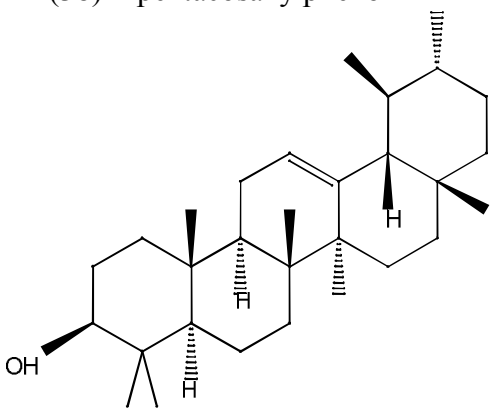
(37) 21-methylene-22-hydroxy-24-oxooctasanoic acid methyl ester



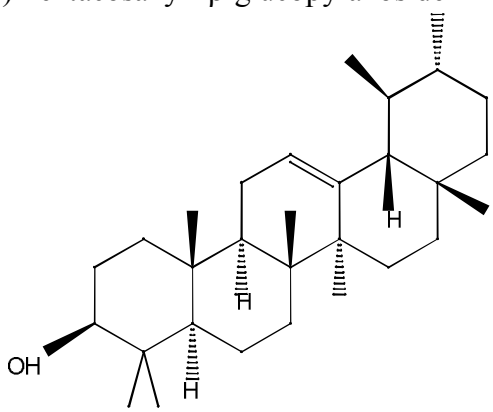
(38) 4-pentacosanylphenol



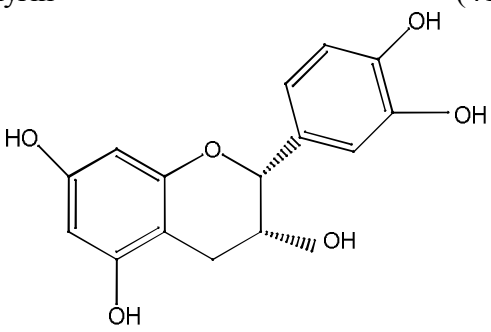
(39) Pentacosanyl- β-glucopyranoside



(40) α-amyrin



(41) Sucrose



(42) Proanthocyanidin

MEDICINAL USES

The root cures night blindness and other defects of sight; useful in elephanthiasis[3]. The bark is hot, acrid, bitter, oily, appetiser, aphrodisiac, laxative, anthelmintic; useful in fracture of bones, diseases of anus, dysentery, piles, hydrocele, cures ulcer and tumours[6]. The leaves are good for diseases of the eye, used as strong astringent, antibacterial, tonic, and cure for pimples, antibacterial[3]. The gum is astringent to the bowels, used in treatment of dysentery, stomatitis, cough, pterygium, corneal, opacities; cures excessive perspiration and flowers are sweet, bitter, hot, acrid; astringent to bowels; increase "vata"; cure "kapha", leprosy, strangury, gout, skin diseases, thirst, burning sensation. A decoction of flowers is given in diarrhoea and haematuria. The juice is useful in eye disease. The fruit and seed are hot, dry, digestible, anthelmintic, aperients; used in urinary discharges, piles; cure "vata"; and "kapha", skin diseases, tumours, abdominal troubles; given for scorpion-sting. The stem bark is used as antifungal[6].

PHARMACOLOGICAL ACTIVITES

Different parts of *Butea* have been reported to possess various biological activities viz. antimicrobial, antifertility, anticonvulsive, anthelmintic, antidiarrhoeal,

wound healing, antigiardiasis and hepatoprotective.

Antimicrobial Activity

A steroidal compound isolated from the methanolic extract of the leaves of *B. monosperma* Linn. have shown antibacterial activity against *Bacilus pumilus*[18] and the methanolic extract possess antimicrobial activity against *Salmonella typhi* MTCC531. The methanolic extract of B. *monosperma* Taub. (Papilionaceae) flowers and *B. superba* Roxb. (Papilionaceae) roots have shown antifungal activity against *Helminthosporium sativum*[19]. The petroleum and ethyl acetate extracts of stem bark from *B. monosperma* have shown antifungal activity against *Cladosporium cladosporioides*. The in-vitro antimicrobial activity of petroleum ether and alcoholic axtract of *B. monosperma* gum was evaluated against various microbial strains. Both extracts showed significant inhibition against garm-positive bacteria and fungal strains. The alcoholic extract of *B. monosperma* (lamk.) Taub. showed significant results against *Bacillus subtilis* and *Staphylococcus aureus*. *Butea monosperma* (L) bark ethanolic and aqueous extract showed good efficacy against *Bacillus cereus*, *Pseudomonas aerugenosa* and *Escherichia Coli* in concentration dependent manner which were grown on MH- Agar medium[20].

Antifertility Activity

Alcoholic extracts of petals of *B. frondosa* flowers and seeds have shown the antiestrogenic, antiimplantation and antifertility activity[21-22]. Flavonoid constituents from the ether, aqueous and alcoholic extract of *B. frondosa* Roxb. flowers have shown antiestrogenic activity.The petroleum ether, alcoholic and aqueous extract of *B. monosperma (*Lam.) Kuntze flowers have shown antiestrogenic and anti-implantation activity**.** Alcoholic extract of *B. parveflora seed* and petroleum ether extract of *B. monosperma (*Lam.) Kuntze seeds and flowers have shown the antifertility activity in female albino rats[23]. Alcoholic extract of *B. monosperma* (Lam.) Kuntze flowers, seeds, leaves and the petroleum ether and benzene extract of *B. monosperma* (Lam.) Kuntze seeds possess the anti-implantation activity in female rats[22]. A flavonoid compound butin isolated from the ethanolic extract of fresh *B. monosperma* seed possess antiimplantation and anti-conceptive activity in female rats.

Anticonvulsive Activity

Petroleum ether extract of *B. monosperma* flowers have shown the anticonvulsive activity[24-25].

Anthelmintic Activity

Palasonin a compound obtained from seeds have shown the anthelmintic activity against *Ascaris lumbricoids* (human) and *Toxicara canis* (dogs). Alkaloids obtained from ammoniacal alcoholic extract of *B. frondosa* seeds have toxic effect on earthworms[26-27]. Water extract of the *B. frondosa* seeds possesses the anthelmintic activity against *Ascaris lumbricoides*. The alcoholic and aqueous extract of the leaves of *B. monosperma* showed significant anthelmintic activity against adult earthworms (*Phertima prosthuma)* when compared with standard Albendazole. It was found that the aqueous extract activity is higher than alcoholic extract[28]. The crude extracts of leaves of *B. monosperma* Lam were investigated for anthelmintic activity against earthworms (*pheretima phostuma*), roundworms (*Ascardia galli*) and tapeworms (*Raillietina spiralis*). It was found that alcohol and ethylacetate extracts showed significant activity at concentration of 100mg/ml against Albendazole as a reference[29]. Crude powder of seeds of *Butea monosperma* administered at doses of 1, 2 and 3 g/kg to sheep naturally infected with mixed species of gastrointestinal nematodes. The maximum reduction of 78.4% in eggs per gram of feces (EPG) 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 EPG[30]. The methanol extract of *Butea monosperma* seeds, tested in vitro, showed significant anthelmintic activity[31].

Antidiarrhoeal Activity

Ethanolic extract of stem bark of *B. monosperma* inhibited castor oil induced diarrhoea and PGE (2) induced enteropooling in albino rats; it also reduced gastrointestinal motility after charcoal meal administration.

Wound Healing

Alcoholic extract of *B. monosperma* possess wound healing by different phases of wound healing, including collagen synthesis and maturation, wound contraction and epithelialization.

Hepatoprotective

Flavonoid from methanolic and aqueous extract of *B. frondosa* Koen ex. Roxb. flowers possesses antihepatotoxic activity on albino rats[32]. Methanolic extract of powdered *B. monosperma* has shown activity against tumor promotion related events of carcinogenesis in rat liver. At different doses it restored the level of malondialdehyde formation (MDA), hydrogen peroxide (H_2O_2) generation, ornithine decarboxylase activity (ODC) and unscheduled DNA synthesis. It also maintained the structural integrity of hepatic cells on the basis of dose dependence and possesses hepatoprotective activity. Recently oral administration of flowers of B. monosperma effectively inhibited the paracetamol induced hepatotoxicity in rabbits. Aqueous extract of

flowers of *B. monosperma* (Fabaceae) was found to possess hepatoprotective activity against CCl_4 induced acute liver damage in rats. Treatment with the aqueous extract of flowers of *B. monosperma* inhibited cell proliferation and accumulation of cells in G1 phase. This was accompanied by a marked reduction in the levels of activated Erk1/2 and SAPK/JNK and induction of apoptotic cell death. Oral administration of the extract in transgenic mice conferred hepatoprotection as its evident from normal serum ALT levels and improved liver histopathology and lowered serum VEGF level[33].

Antihypertensive Activity

Water extract of the *B. frondosa* seeds possesses the antihypertensive activity in dogs[27]. On oral administration for 4 days of composite mixture containing crude drug powder like *Mallotus philippinesis, Embelia ribes* and *Butea frondosa* to the proportion of 2:2:1 then hymenolepis ova was completely disappeared. Butein (3, 4, 2', 4'-tetrahydroxychalcone) isolated from flowers of *B. frondosa* have shown the antinephritic activity.

Antitumor Activity

Intraperitoneal administration of the aqueous extract of flowers of B. monosperma in the X15-*myc* oncomice showed antitumorgenic activity by maintaining liver architecture and nuclear morphometry but also down-regulated the serum VEGF levels. Immunohistochemical staining of liver sections with anti-Ribosomal protein S27a antibody showed post-treatment abolition of this proliferation marker from the tumor tissue[34].

Antidiabetic Activity

The ethanolic extract of *Butea monosperma* (BMEE) was studied in glucose-loaded and alloxan-induced diabetic rats. Single dose treatment of BMEE (200 mg/kg, p.o.) significantly improved glucose tolerance and caused reduction in blood glucose level in alloxan-induced diabetic rats. Repeated oral treatment with BMEE (200 mg/kg/day) for 2 weeks significantly reduced blood glucose, serum cholesterol and improved HDL-cholesterol and albumin as compared to diabetic control group[35]. Significant hypoglycemic and anti-oxidant activity in ethanolic extract of B. monosperma leaves (BMEE) was found when tested on diabetes and diabetes-induced oxidative stress in alloxan (ALXN)-induced diabetic male adult mice[36]. The ethanolic extract of the Butea monosperma seeds (300 mg/kg b.w.) when administered orally exhibited significant antidiabetic, hypolipaemic and antiperoxidative effects in non-insulin dependent diabetes mellitus rats. Daily treatment of alloxan-induced diabetic animals with 50% ethanolic extract of B. monosperma flowers (BMEE) for 45 days significantly lowered blood glucose level thereby preventing steep onset of hyperglycemia which was observed after alloxan administration and maintained body weight and blood glucose level close to the values observed in normal control and glibenclamide-treated diabetic mice[37].

Anti-Inflammatory Activity

The antinflammatory activity of methanolic extract of *Butea monosperma* evaluated by carrageenin induced paw edema and cotton pellet granuloma. In carrageenin induced paw edema at oral doses of 600 and 800 mg/kg inhibition of paw edema, by 26 and 35% and in cotton pellet granuloma inhibition of granuloma tissue formation, by 22 and 28%.

Thyroid Inhibitory, Antiperoxidative and Hypoglycemic Effects

Stigmasterol, isolated from the bark of *Butea monosperma* was evaluated for thyroid hormone and glucose regulatory efficacy in mice. The administration at 2.6 mg/kg/d for 20 days reduced serum triiodothyronine (T3), thyroxin (T4) and glucose concentrations as well as the activity of hepatic glucose-6-phophatase (G-6-Pase) with a increase in insulin showed its thyroid inhibiting and hypoglycemic properties. Antioxidative potential due to decrease in the hepatic lipid peroxidation (LPO) and an increase in the activities of catalase (CAT), superoxide dismutase (SOD) and glutathione (GSH). The highest concentration tested (5.2 mg/kg) evoked pro-oxidative activity[38].

Free Radical Scavenging Activity

Free radical scavenging activity of various fractions derived from total methanol extract of flowers of *B. monosperma* were evaluated by using different in-vitro models like reducing power assay, scavenging of 2,2 diphenyl-1-picrylhydrazyl (DPPH) radial, nitric oxide radical, superoxide anion radical, hydroxyl radical and inhibition of erythrocytes 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 activity could be due to the higher phenolic contents in the extracts[39].

CONCLUSION

Herbs are the natural drugs used to regain the alterations made in normal physiological system by foreign organisms or by any malfunctioning of the body. It is very essential to have a proper documentation of medicinal plants and to know their potential for the improvement of health and hygiene through an eco friendly system. Thus importance should be given to the potentiality of ethnomedicinal studies as these can

provide a very effective strategy for the discovery of medicinally active identity. The present review reveals that the plant *Butea monospora* is used for treating various ailments. The tree is of immense medicinal value. The root traditionally used as antifertility agent, cures night blindness and other defects of sight; useful in elephanthiasis. It elicits on all aspects of the herb and throws the attention to set the mind of the researchers to carry out the work for developing its various formulations, which can ultimately be beneficial for the human beings as well as animals.

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