BOTANICAL, PHYTOCHEMICAL AND BIOLOGICAL INVESTIGATION OF *BUTEA MONOAPERMA* (LAM.) KUNTZE

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Summary

In the last few decades there has been an exponential growth in the field of herbal medicine. It is getting popularized in developing and developed countries owing to its natural origin and lesser side effects. One such medicinal plant is *Butea monosperma* (Lam.) Kuntze **(**Fabaceae**),** which is commonly used as palas. It is a medium sized deciduous tree which is mainly found in ascending of Himalayas up to 900 m height and in peninsular India up to 1200 m height. All parts of plant are important *viz*. Bark, leaves, flowers, seed etc. This plant is used ethanobotanically in Ayurveda, Unani, Homeopathic and Allopathic system of medicines as astringent, aphrodisiac, antifertility, analgesic, burning sensation, diuretics, diarrhea, dysentery, depurative, filariasis, gout, helminthiasis, leprosy, night blindness, piles, skin diseases, sore throat, snake bite, tumours, ulcer *etc.* The plant is reported to possess anthelmintic, anti convulsion, anti diarrheal, anti fungal, anti diabetic, hypoglycemic, anti hyperlipidaemic, anti inflammatory, anti oxidant, wound healing, anti fertility and hepatoprotective Activity. All these uses are due to the present of certain phytoconstituent in the plant. The major phytoconstituent reported in this plant are Isobutrin, butrin, butin, butein, chalcones, aurones, isobutyine, palasitrin, 3',4',7-trihydroxyflavone, palsitrin, Coreopsin, isocoreopsin, sulphurein, monospermoside, isomonospermoside, quercetin, prunetin, Lupenone, lupeol. The aim of present article is to explore the medicinal importance of the plant *Butea monosperma*

Key words:- *Butea monosperma,* Palas, phytoconstituents, activity

Introduction

***Butea monosperma* (Lam.) Kuntze:**

Vernacular Names [1, 2]:

Hindi- Dhak, Palas, Chichra, Kakria, Kankeri, Tesu, **English-** Flame of forest, **Sanskrit-** Palasha, Bijasneha, Bramhapadapa, Kamalasana, Karaka, Kashtadru, **Gujarati-** Khakra, Khakda, Khakhado, Palassoo, **Bengali and Marathi-** Nim, Palas, **Kannada-** Mutthuga, **Malyalam-** Palas in samatha, Chamatha, Brahmavriksham, Kimshukam, **Tamil-** Parasu, Palashamaram, Puppalasu, Purasu, Sira, Tikkuru, **Telgu-** Moduga, Tellamoduga, Palasamu, Kimsukamu, Togarumoduga, **Oriya-** Polas, Porasur, **Punjabi-** Dhak, Palas, Chichra, **Urdu-** Palashpapra, **Tulu-** Palasa, **Singhalese-** Parasu

Scientific Classification:

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

Different Species Available of Genus Butea: *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.*

Description: It is a medium sized deciduous tree with somewhat crooked trunk, up to 15 m in height and 1.6-2.0 m (Sometime up to 3.8) in girth the tree is silviculturally important, as it is one of the commonest on the plains of India and capable of thriving where most species will not grow. It is mainly found in ascending of Himalayas up to 900 m height and in peninsular India up to 1200 m height. It is rarely found in most acid region. It grows better in waterlogged situations, on black cotton soils, even on saline, alkaline, and swampy badly drained soils and on barren lands. In kerala, it is found in drier parts, growing in grassland up to 1200 m height. In the natural habitat of the tree, the absolute maximum shade-temperature varies from 37.8^0 to 48.9^0 and the absolute minimum from 3.9^0 to 15.6^0 and the normal rain fall from 62.5 to 450 cm or more. All part of plant *viz.* Bark, leaves, flowers, seed etc. possesses medicinal action **[2].**

Leaves

Flowers

Leaves are long-petioled, 3- foliolate. It begins to fall during Nov-Dec and by the end of January the tree is leafless oe nearly so. The new leaves appear in April or early May**; Petiole** slender, cylindrical, thickened at the base, downy when young; **Stipules** small, deciduous, linear-lanceolate; **Leaflets** are 3-8 inches long, coriaceous, broadly ovate, densely finely silky below, flower bud dark brown; **Bark is** bluish grey, or light brown**; Flowers** are large, bright orange red to somewhat yellow and produced in rigid racemes. Flowering begins in January and continuous till the end of April, according to locality. Seasonal conditions influence the time of flowering to a considerable extent, and flowering is earlier than usual in dry season; **Fruits** are pods with a single seed in each. Pods ripen in May-June. Fruit pods are velvety brown, base wing like. Pods are pendulous, silky- tomentose, 10-13 cm long, containing 1 seed at its apex**; Seeds** are flat, reniform, 3.3-3.8 cm × 2.2-2.5 cm. The pods with the seed each at the apex ripen during May-June. The seed loses its vitality within a year, but the fresh seed has a very high germinating power. The seed should be collected before the rains commerce either from tree or off the ground **[2]**.

Traditional Uses: *Butea monosperma* is extensibly used in Ayurveda, Unani and Homeopathic medicine and has become a cynosure of modern medicine. The plants of this genus are well known for their colouring matters. Commonly *Butea monosperma* is used as tonic, astringent, aphrodisiac and diuretics [3]. **Roots** are useful in filariasis, night blindness, helminthiasis, piles, ulcer and tumours [4]. It is reported to possess antifertility, aphrodisiac and analgesic activities **[5]**. **Flowers** are useful in diarrhoea, astringent, diuretic, depurative, tonic, leprosy, skin diseases, gout, thirst, burning sensation. The **stem bark** is useful in indigenous medicine for the treatment of dyspepsia, diarrhoea, dysentery, ulcer, sore throat and snake bite. Besides medicinal uses it is also having the economic use such as leaves are used for making platters, cups and bowls **[6]. Bark fibres** are used for making cordage **[5]. Wood** is used for well curbs and water scoop. It is a cheap board wood .Wood pulp is suitable for newsprint manufacturing **[7].** Butea is also a host to the Lac insect, which produces natural lacquer **[8]**.

Reported Phytoconstituents: A number of constituents have been isolated from the various species of genus *Butea* and they are mainly found in flowers, stem bark, seed, seed coat *etc*.

Flowers:
Flavonoids:- Isobutrin (1) and butrin (2) **[9, 10]**, chalcones, aurones, isobutyine, palasitrin, 3',4',7- trihydroxyflavone.
Flavone Glycoside:- 5,7-dihydroxy-3,6,4'trimethoxy flavone-7-O-α-L-xylopyranosyl-(1-3)-O-α-L-arabinopyranosy1-(1-4)-O-β-D-galactopyranoside (3) **[11].**

Flavonoids:- butin (4), butein (5), palsitrin (6)
Glycosides:- Coreopsin (7), isocoreopsin (8) and sulphurein (9), monospermoside (10) and isomonospermoside (11) **[12, 13].**

Stem Bark:
Flavone: quercetin (12)**,** Medicarpin (13) **[14]**
Isoflavanoid:- 5-methoxygenistein (14) and prunetin (15) ,Lupenone (16), lupeol (17) and β sitosterol (18) **[15]**.
Miscellaneous:- Stigmasterol (19), stigmasterol- β-D-glucopyranoside (20) and nonacosanoic acid (21) **[16],** 3-methoxy-8,9-methylene dioxypterocarp-6-ene (22), 21-methylene-22-hydroxy-24-oxooctasanoic acid methyl ester, 4-pentacosanylphenol (23) and pentacosanyl- β-glucopyranoside (24) **[17].**

Seed:
Flavone glycoside:- 5,2'-dihydroxy-3,6,7-trimethoxy flavone -5-O-β-D-xylopyransyl-(1-4)-O-β-D-glycopyranoside (25) **[18].**
Alkaloids:- monospermin **[19].**
Aliphatic Compounds:- 2-hydroxy-ω-methyl allophanic acids (26) **[20].**
δ-Lactone:- heneicosanoic (27) acid **[21].**
Fatty Acids:- Myristic, palmitic, stearic, arachidic, behenic, lignoceric, oleic, linoleic and linolenic, Monospermin.
Acid Imide:- 15- Hydroxypentacosanoic acid nheneicosanoic acid δ-lactone, 10, 16-dihydroxyhexadecanoic acid, Phosphatidylcholine, phosphatidylethanolamine and phosphatidylinositol
Miscellaneous:- Palasonin (28), nitrogenous acidic compound (29) and its methyl ester (30**) [22, 23],** β–sitosterol (31) **[24];** β-sitosterol-β-D-glucoside (32)**,** α-amyrin (33) and sucrose (34)**,** Proanthocyanidins (35) **[25].**

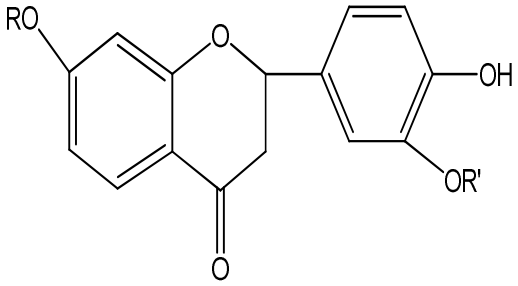
Seed Coat:
Aliphatic Compound:- 15-hydroxy pentacosanoic acid (36) and 1-carbomethoxy-2-carbomethydrazine (37) **[26],** 3-α-hydroxy-euph-25-ene (38) and 2,14-dihydroxy-11,12-dimethyl-8-oxo-octadec-11-enylcyclohexane (39) **[27].**

Root- The root of *Butea monosperma* contains glucose, glycine, a glycoside (aglycon) and an aromatic hydroxy compound **[28].**

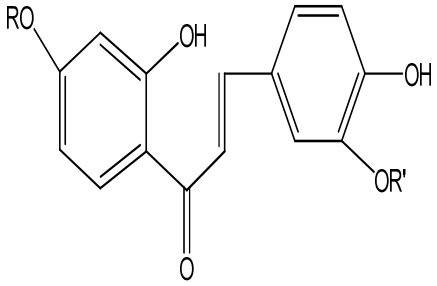
Leaves - Glucoside, Kino-oil containing oleic and linoleic acid, palmitic and lignoceric acid **[29].**

Resin - Jalaric esters I, II and laccijalaric esters III, IV.; Z-amyrin, e-sitosterone and its glucoside ,sucrose, lactone-nheneicosanoic acid-{-lactone **[30, 31].**

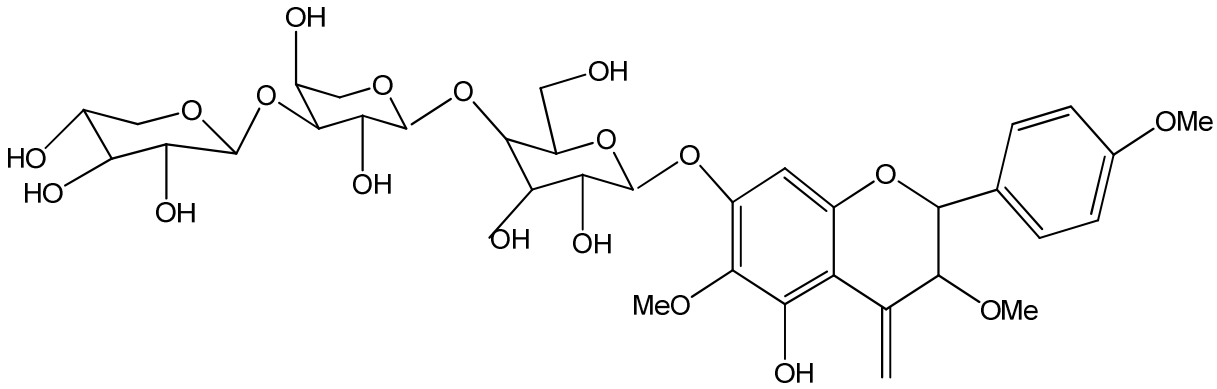
Sap - Chalcones, butein , butin, colourless isomeric flavanone and its glucosides, butrin (1)



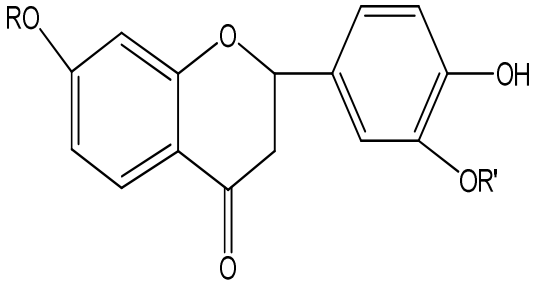
(1) Butrin R=R'= Glucosyl



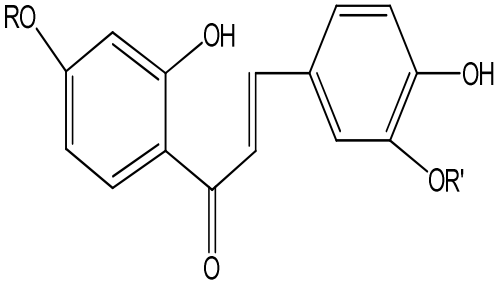
(2) Isobutrin R=R'= Glucosyl



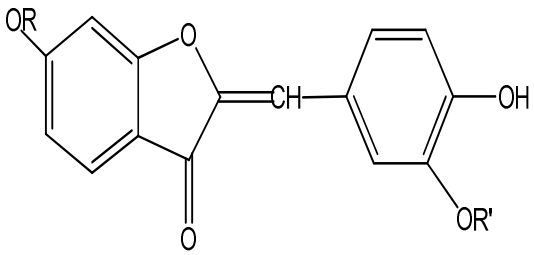
(3) 5,7-dihydroxy-3,6,4'trimethoxyflavone-7-o-α-L-xylopyranosyl-(1-3)-o-α-L-rabinopyranosy1-(1-4)-o-β-D-galactopyranoside



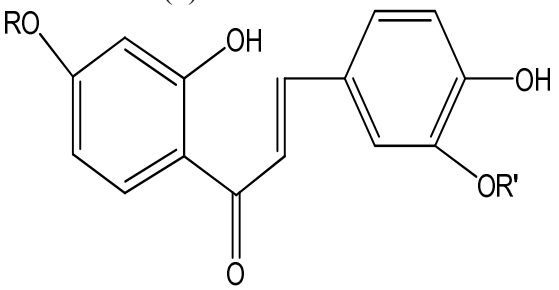
(4) Butin R=R'= H



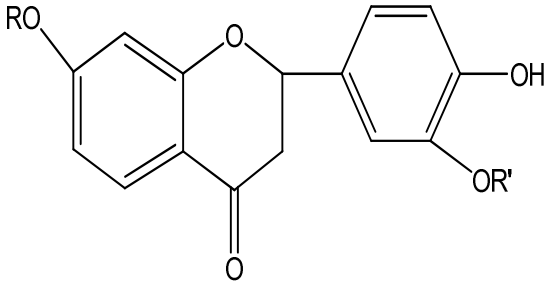
(5) Butein R=R'= H



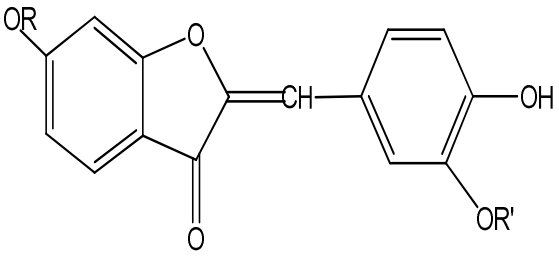
(6) Palasitrin R=R'= Glucosyl



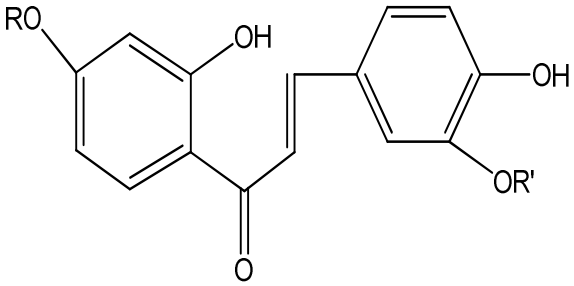
(7) Coreopsin R= Glucosyl, R'= H



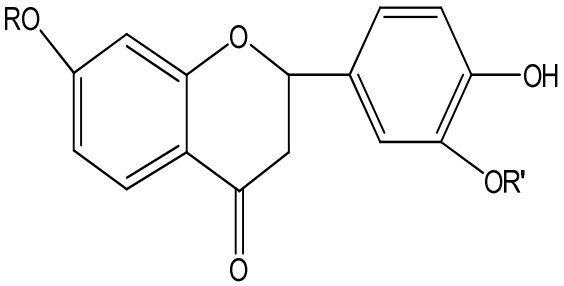
(8) Isocoreopsin R= Glucosyl, R'= H



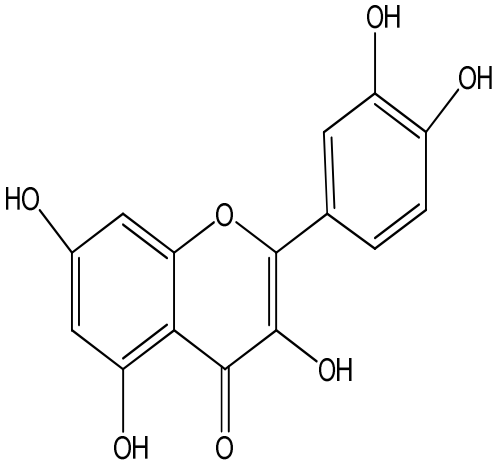
(9) Sulphurein R= Glucosyl, R'= H



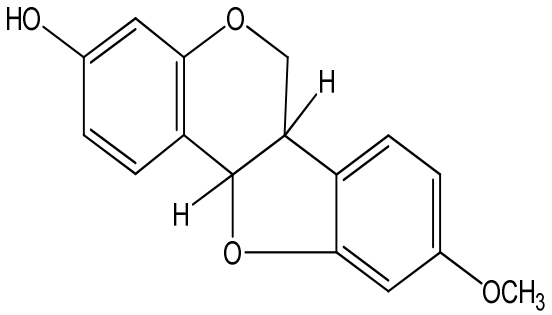
(10) Monospermoside R= H, R'= Glucosyl



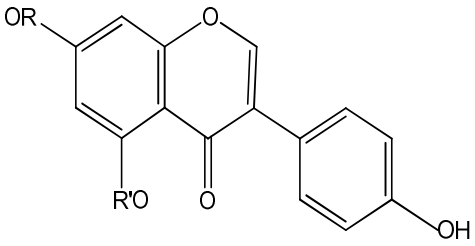
(11) Isomonospermoside R= H, R'= Glucosyl



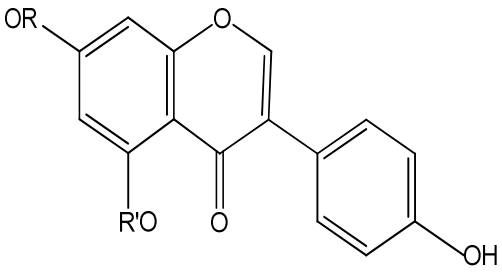
(12) Quercetin



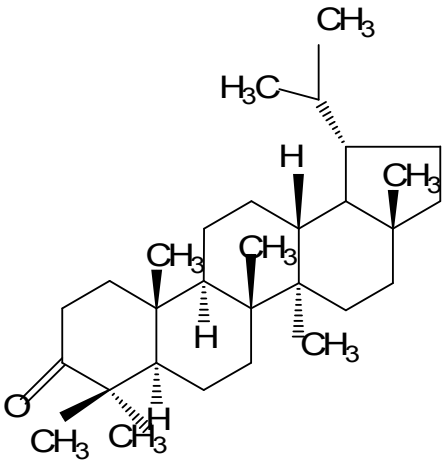
(13) Medicarpin



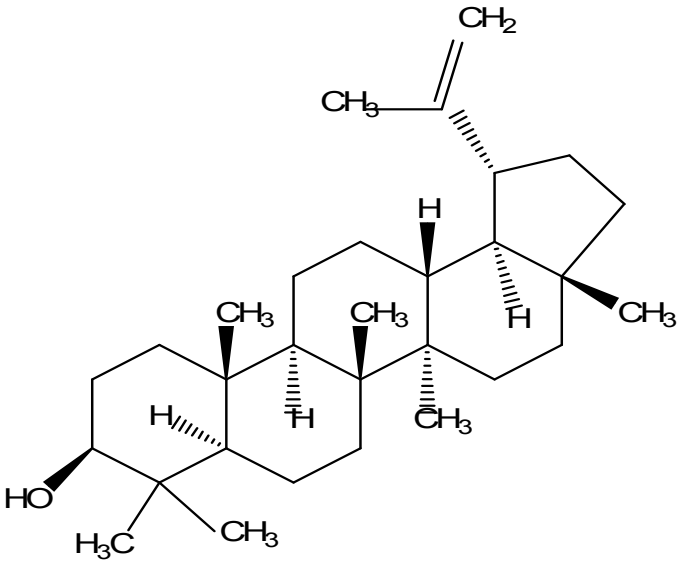
(14) 5-methoxygenistein R=H, R'= CH_3



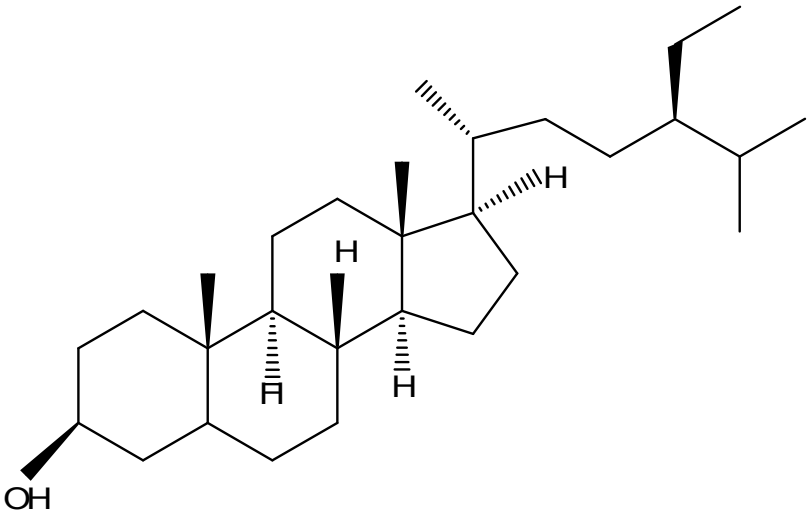
(15) Prunetein R=CH_3, R'= H



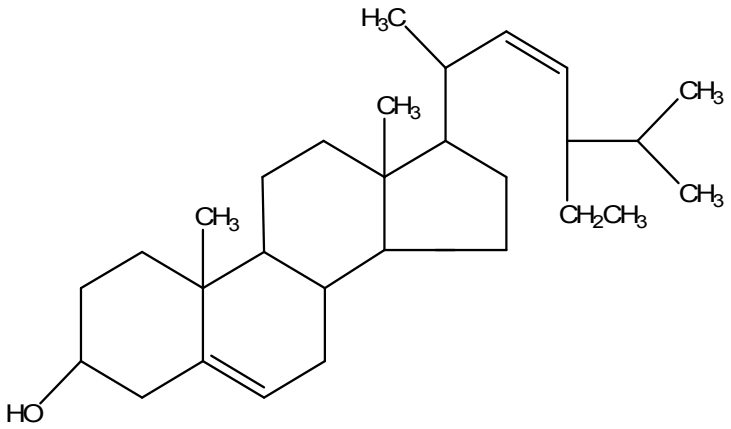
(16) Lupenone



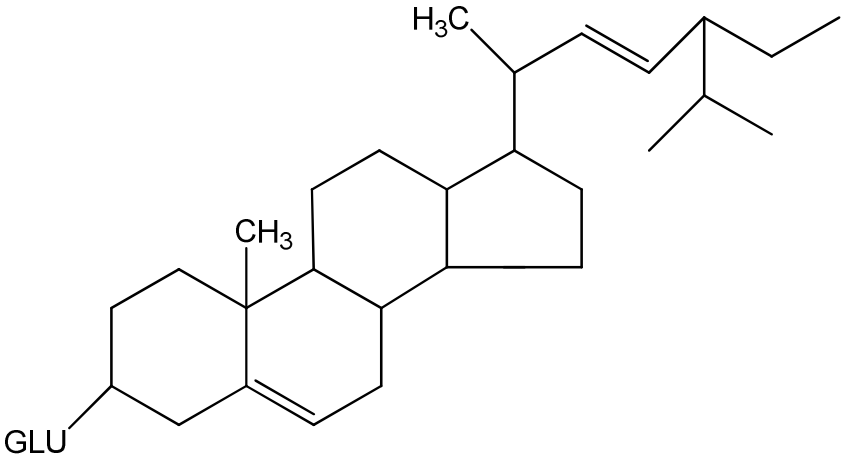
(17) Lupeol



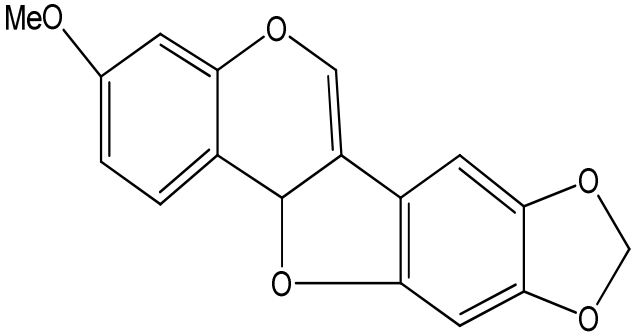
(18) β-Sitosterol



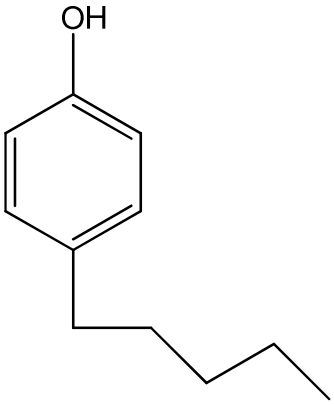
(19) Stigmasterol



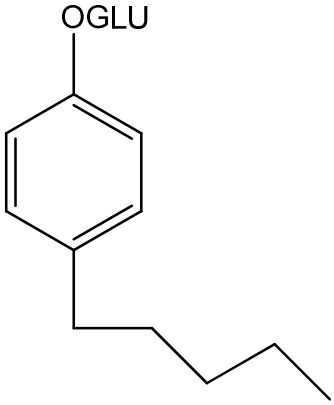
(20) Stigmasterol- β-D-glucopyranoside



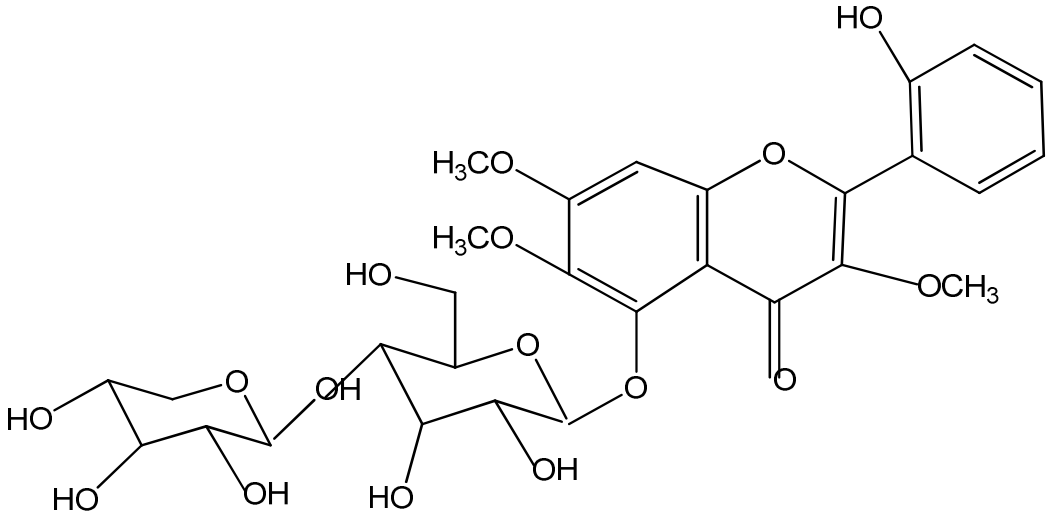
(22) 3-methoxy-8,9-methylene dioxypterocarp-6-ene



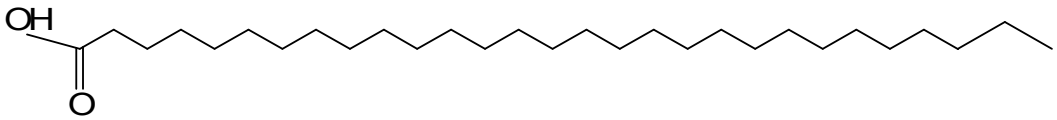
(23) 4-pentacosanylphenol



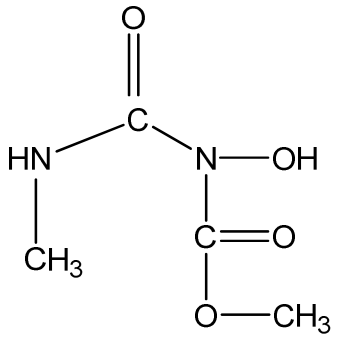
(24) Pentacosanyl- β-glucopyranoside



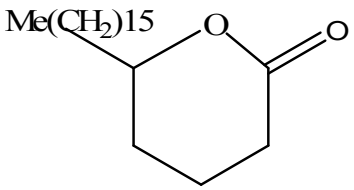
(25) 5,2'-dihydroxy-3,6,7-trimethoxyflavone-5-o-β-D-xylopyransyl-(1-4)-o-β-D-glycopyranoside



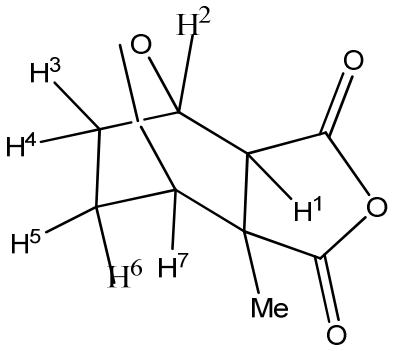
(21) Nonacosanoic acid



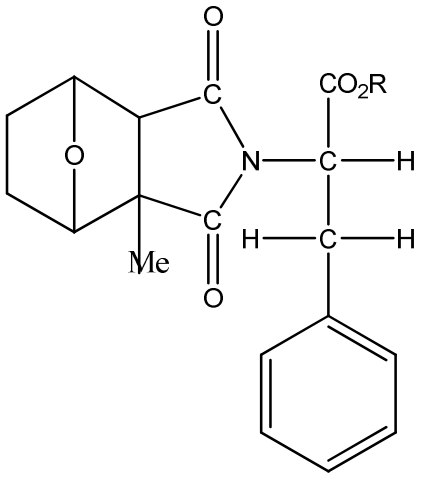
(26) 2-hydroxy-ω-methyl allophanic acids



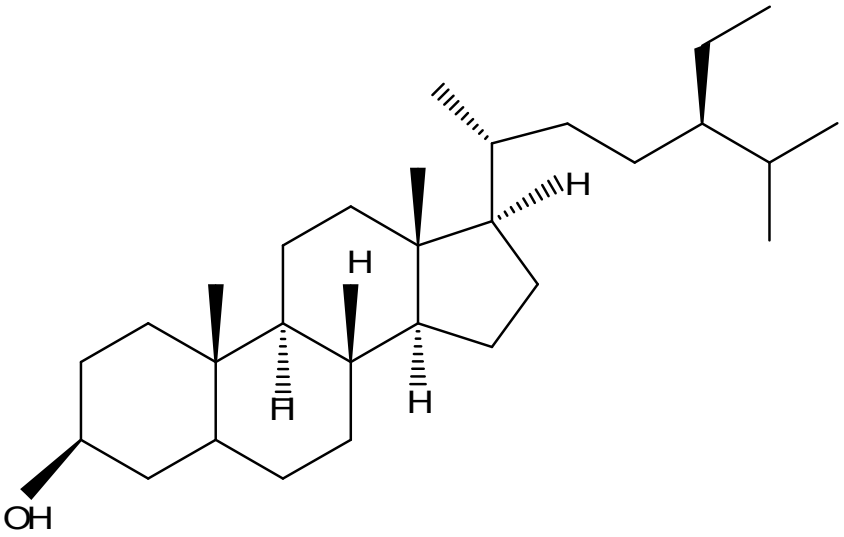
(27) δ-lactone of heneicosanoic



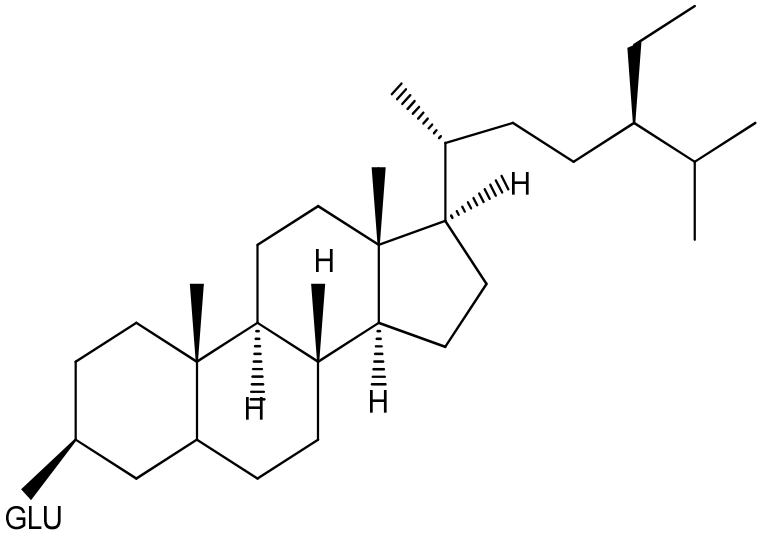
(28) Palasonin



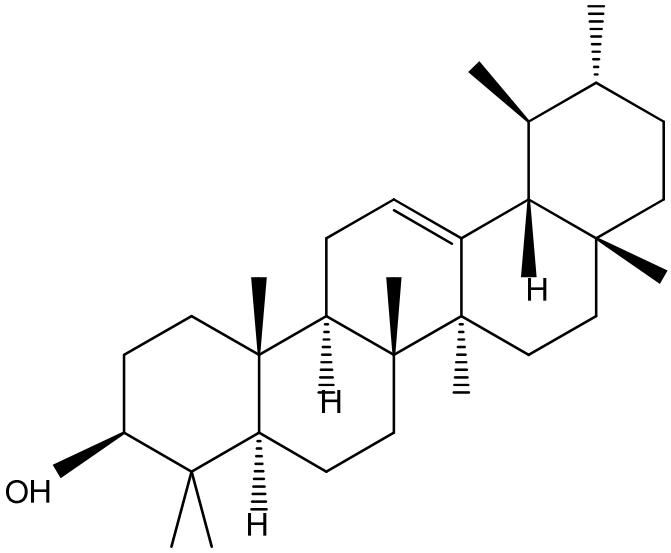
(29) R = H, Nitrogenous acidic compound
(30) R= Me, Methyl ester of nitrogenous acidic compound



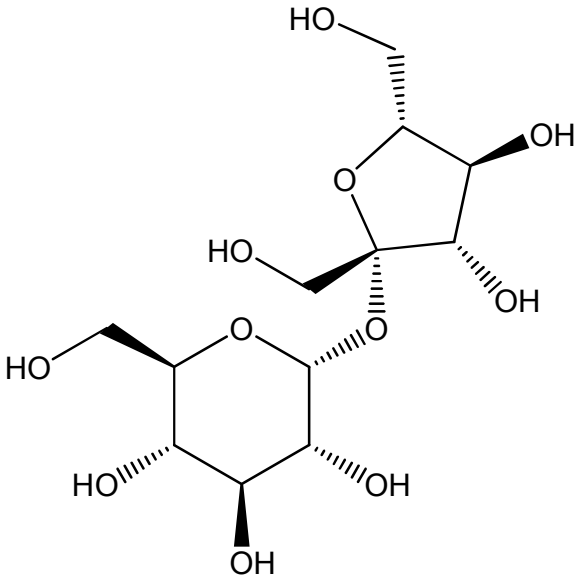
(31) β-Sitosterol



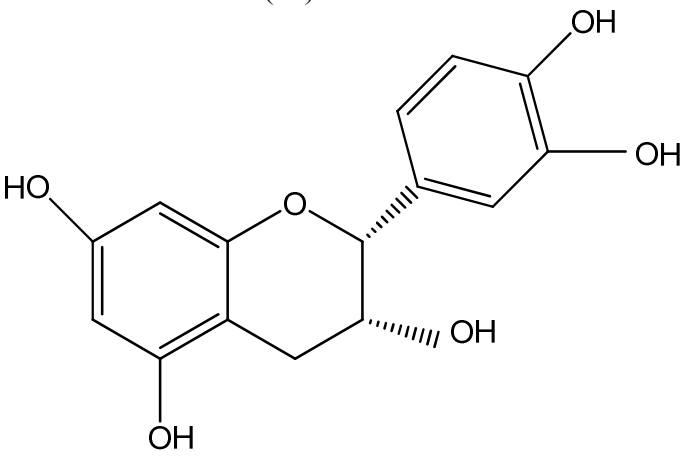
(32) β-sitosterol-β-D-glucoside



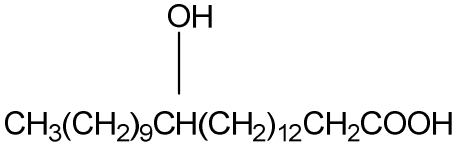
(33) α-amyrin



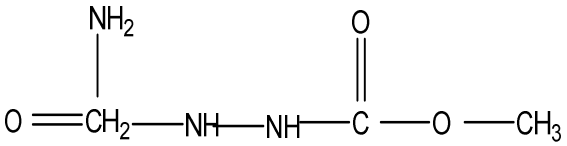
(34) Sucrose



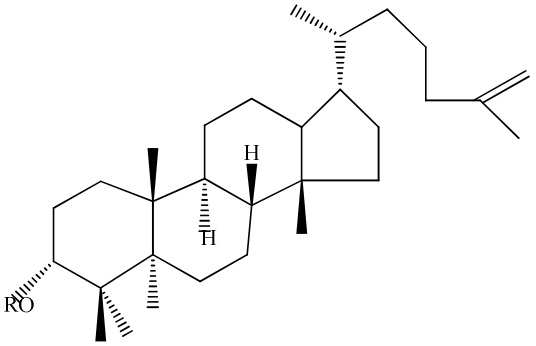
(35) Proanthocyanidins



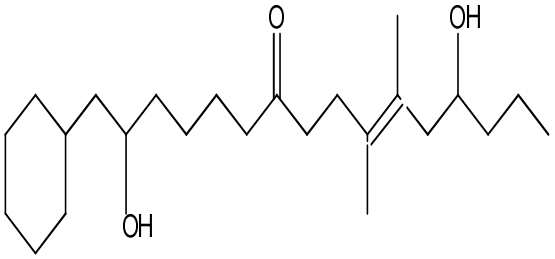
(36) 15-hydroxy pentacosanoic acid



(37) 1-carbomethoxy-2-carbomethydrazine



(38) 3-α-hydroxy-euph-25-ene



(39) 2,14-dihydroxy-11,12-dimethyl-8-oxo-octadec-11-enylcyclohexane

Reported Biological Activities: *Butea monosperma* have been reported to possess antihelmintic, anticonvulsive, antidiarrhoeal, anti fungal, anti diabetic, Hypoglycemic & anti hyperlipidaemic activity, Anti inflammatory, Anti oxidant activity, Wound healing activity, Anti fertility activity, Hepatoprotective activity.

Anthelmintic Activity:- The crude powder of *B. monosperma* seeds (CP) showed a dose-dependent (1–3 g/kg) and a time-dependent anthelmintic activity in sheep. CP showed a maximum reduction of 78.4% in eggs per gram of feces (EPG) on day 10 post-treatment which was maintained till day 14 with the dose of 3 g/kg. In comparison to this, the standard anthelmintic agent levamisole exhibited 99.1% (Pb0.001) reduction in EPG with 7.5 mg/kg. The anthelmintic activity of different species of *Butea* has been reported against *Ascaridia galli*, *Ascaris lumbricoides*, earthworms, *Toxocara canis*, *Oxyurids*, *Dipylidium caninum* and *Taenia* [32]. The methanol extract of *B. monosperma* seeds showed potent anthelmintic activity against *Caenorhabditis elegans* (wild strain, N2 type) **[33].** Palasonin a phytoconstituent isolated from the seeds of *B. monosperma reported to possess* anthelmintic activity against *Ascaris lumbricoids* and *Toxicara canis* **[34, 35].**

Anti Convulsion Activity:- The acetone-soluble part of the petroleum ether extract of *B. monosperma* **[36].** From the petroleum ether extract of *B. monosperma* flowers a triterpene (TBM) present in the n-hexane:ethyl acetate (1:1) fraction; exhibited anticonvulsant activity against seizures induced by maximum electroshock (MES) and its PD_{50} was found to be 34.2 ± 18.1 mg/kg. TBM also inhibited seizures induced by pentylenetetrazol (PTZ), electrical kindling, and the combination of lithium sulfate and pilocarpine nitrate (Li-Pilo). However, TBM was not effective against seizures induced by strychnine and picrotoxin. TBM exhibited depressant effect on the central nervous system. After repeated use for 7 days, the PD50 (MES) of TBM increased to 51.5 ± 12.1 mg/kg. Similarly, after repeated use of TBM, the duration of sleep induced by pentobarbital was not reduced significantly **[37].**

Anti Diarrheal Activity:- The ethanolic extract of stem bark of *Butea monosperma* exhibited significant anti-diarrheal activity against castor oil induced diarrhoea in rats. The extract had a similar activity as loperamide, when tested at 400 and 800 mg/kg and significantly inhibited the frequency of defecation and the wetness of the faecal droppings when compared to control rats.

The extract appears to act on all parts of the intestine. Thus, it reduced the intestinal propulsive movement in the charcoal meal treated model; at 800 mg/kg *B. monosperma* extract showed activity similar to that of atropine. The extract at different dose levels 400 and 800 mg/kg significantly inhibited the PGE2 induced intestinal fluid accumulation (enteropooling). These observations tend to suggest that the EBM extract at doses of 400 and 800 mg/kg reduced diarrhoea by inhibiting gastrointestinal motility and PGE2 induced enteropooling **[38]**

Anti Fungal Activity:- An active phytoconstituent (-)-medicarpin obtained from the petroleum and ethyl acetate extracts of the stem bark of *Buteu monosperma* possess antifungal activity against *Cladosporium cludosporioides*. Anti fungal activity of medicarpin was found to be greater than that of Renlate, a standard fungicide. The acetate salt of medicarpin also exhibited significant activity against C. *cladosporiodes* **[39].**

Anti Diabetic Activity:- Ethanolic extract of flowers of *Butea monosperma* orally at the dose of 200 mg/kg prevented the rise in blood glucose level significantly ($P < 0.05$) at 1/2 h, after glucose administration. A single dose treatment of this extract in diabetic rats 6 h after treatment caused a significant ($P < 0.001$) decrease in blood glucose from 311.6 ± 11.95 (at 0 h) to 286.6 ± 10.20 mg %. Repeated dose administration further reduced blood glucose to 272.2 ± 4.55 mg % 6 h after last treatment. It significantly reduced serum cholesterol (13.5%) and increased HDL-cholesterol (11.5%) and albumin (29.7%) compared to diabetic group **[40].**

Hypoglycemic and Anti Hyperlipidaemic Activity:- The four-week treatment with ethanolic extract from the seeds of *Butea monosperma* resulted in significant ($P < 0.05$; 17%) anti hyperglycemic effect and improved glucose tolerance in NIDDM rats. However, it was found to have no influence on glucose concentration in normal animals. The hepatic glycogen content and hexokinase activity rose significantly ($P<0.05$, 41%; $P<0.01$, 29% respectively) in NIDDM rats upon treatment orally with above extract, which is a sign of improved glucose metabolism. The treatment of above mentioned extract to NIDDM animals showed a significant reduction of plasma TC ($P<0.05$, 23%), TG ($P<0.01$, 20%), LDL-C ($P<0.05$, 46%) and hepatic TC ($P<b0.001$, 39%) and TG ($P<0.05$, 15%) and improvement in plasma HDL-C (Pb0.05, 52%) **[41].**

Anti Inflammatory:- Methanolic extract of flowers at dose of 600 and 800 mg/kg caused significant inhibition of paw edema, by 26 and 35% respectively, 3 h after carrageenin administration and at the same dose it causes significant inhibition of granuloma tissue formation by 22 and 28% respectively, when compared with control. Methanolic extract of flowers was also found to be effective in lowering the elevated levels of serum lysosomal enzymes (SGOT, SGPT and ALP), which are said to play an important role in inflammation, there by providing a simple and effective tool in assessing inflammatory activity **[42].**

Anti Oxidant Activity:- Methanolic extract of flowers at 600 and 800 mg/kg dose was found to be effective in lowering the levels of lipid peroxides, there by inhibiting lipid peroxidation by 17 and 31% respectively, this effect of could probable be due to its anti-oxidant activity **[42].**

Wound Healing Activity:- Alcoholic extract from the bark of *B. monosperma* significantly increased the collagen content from day 4 to day 12 by 108 to 136% respectively. A similar trend

in the treated groups was observed, with a significant increase in the DNA content (44–64%), hexosamine and uronic acid. The ground substratum for collagen synthesis gradually increased till day 8 by 86 and 48% respectively. The treated wounds were found to contract much faster. The epithelialization period of the treated wounds showed a significant decrease of 33% on day 8. A significant increase of 112% in tensile strength was observed on day 8 treated groups. Also, the lipid peroxides levels resulted in a half-fold decrease in all the *B. monosperma* treated groups **[43].**

Anti Fertility Activity:- Butin (flavonoid) 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 day 5 of pregnancy showed anti-implantation activity in 40%, 70% and 90% of the treated animals, respectively **[44].** The petroleum ether, alcoholic and aqueous extract from the flowers of *B. monosperma* found to have antiesterogenic and anti-implantation activity **[45].**

Hepatoprotective Activity:- Methanolic extract of powdered *B. monosperma* show 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 maintains the structural integrity of hepatic cells on the basis of dose dependence and possesses hepatoprotective activity

Conclusion

The plant *Butea monosperma* has a good potential of medicinal values. Further study on phytoconstituent and pharmacological action are suggested to validate the claims. So far, not much attention has been focused on the plant. The aim of present article is to explore the medicinal importance of the plant *Butea monosperma.*

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