Acta Scientific Pharmaceutical Sciences (ISSN: 2581-5423)

Volume 3 Issue 4 April 2019

Review Article

# *Butea Monosperma*: Phytochemistry and Pharmacology

**Prashant Tiwari*, Susmita Jena and Pratap Kumar Sahu**

*School of Pharmaceutical Sciences, Siksha O Anusandhan (Deemed to be University), Bhubaneswar, India*

***Corresponding Author:** Prashant Tiwari, School of Pharmaceutical Sciences, Siksha O Anusandhan (Deemed to be University), Bhubaneswar, India.

**Received:** January 19, 2019; **Published:** March 07, 2019

## Abstract

*Butea monosperma* (BM) is a well-known medicinal plant which is a moderate sized deciduous tree and widely distributed in India, Ceylon and Burma. It has been used in traditional medicine practice from ancient time. It is also known as flame of forest commonly known as Palash or Dhak. Palash is described in Charaka Samhita, Susruta Samhita, Upanisads, Vedas, Astanga Sangraha and Astanga Hridaya. BM belonging to the family Leguminosae has a wide range of active principles like coreopsin, isocoreopsin, sulphurein, butein, butin, isobutrin, monospermoside and isomonospermoside, aurones, chalcones, flavonoids (palasitrin, prunetin) and steroids. BM contains phytoconstituents such as alkaloids, flavonoids, phenolic compounds, amino acids, glycosides, steroids etc. The pharmacological activity is mainly shown by flowers, seeds, barks, fruits, leaves etc. The current review focused on following pharmacological actions like hepatoprotective, antifertility, antifilarial, anti-diabetic, antiviral, anthelmintic, anticonvulsant, antifungal, antimicrobial, antiestrogenic, anticancer, antiinflammatory, antioxidant, antiulcer, wound healing, anti-diarrhoeal, anti-implantation, antidopaminergic, antimycobacterial, osteogenic and osteoprotective activity. These medicinal properties may provide potential active principles with higher efficacy and minimum side effects as compared to available synthetic drugs.

**Keywords:** *Butea monosperma*; Phytochemistry; Pharmacology; Ayurveda; Palash

## Introduction

*Butea monosperma* (BM) commonly known as flame tree, belongs to the subfamily *Caesalpinioideae*, family *Fabaceae* (formerly Leguminosae). The plant is commonly called as Palash tree in India. It grows throughout India as well as South Asian peninsula [1]. It is a medium sized deciduous tree. It grows about 10-15 meters in height. It looks like small bush when the height is 1-2meters due to more branching. Its flower is odourless and looks reddish in the flowering season during springs and leaves are trifoliate. The plant is having numerous medicinal properties like appetizer, laxative, anthelmintic and aphrodisiac etc. The following parts of plants may be used such as flower, gum, seed, leaf, and bark1 [2-9]. As per Ayurveda, BM also has the property of reducing Kapha and Vata [10]. The various parts of BM contains many active constituents e.g. butein, butrin, flavonoid and steroids (flower), glucose, glycosides (roots) tannin (gum), oil, proteinase and polypeptidase (seed) etc. The present article describes the phytocemical and pharmacological activities of different parts of BM.

### Ayurvedic context of *Butea monosperma*

BM has a great impact as a medicinal herb used in Ayurvedic medicine. The specific name monosperma means one seeded and refers to the fruit with a single seed near its apex belonging to the family Fabaceae [11]. On exhaustive review of Ayurveda, BM was originated as Palash. Its characteristic is well defined in Charaka Samhita, Susruta Samhita, Astanga Sangraha, Astanga Hrdaya Vedas, and Upanisads. In Charaka Samhita, the plant is defined in Mahakasaya [12]. In Susruta Samhita, Palash is considered as Ambasthadi, Nyagrodhadi, Muskakadi and Rodhradi. Similarly, in Astanga Hrdaya and Susruta Samhita Palash is also described in Ambasthadi, Muskakadi, Nyagrodhadi Gana and Rodhradi. In Astanga Sangraha, Vagbhata mentioned Palash in Asanadi, Rodhradi, Muskakadi, Ambasthadi and Nyagrodhadi Gana [11]. Palash also has detailed description in Samhita's such as Harita Samhita, Bhela Samhita, Sharangadhar Samhita and Kasyapa Samhita. It is also stated in Cikitsagranthas as Gadanigraha, Bhaishajya Ratnavali, Bhavaprakasha Samhita and Cakradutta. Nighantus have defined the goodness

of Palash in various disease for example the rasa of Palash is useful in kasaya and tikta. According to Bhavaprakash Nighantu the fruit part of the BM is applicable in Krimi, Arsa and Vatakaphaja rogas [13].

## Phytochemistry

BM contains various phytoconstituents like alkaloids, flavonoids, phenolic compounds, amino acids, glycosides, resin, saponin and steroids (Table 1). Here we have described various constituents present in different parts such as flower, gum, seed, leaves, bark and stem. The constituents are as follows:

- **Flower:** It contains triterpene butrin, isobutrin, coreopsin, sulphurein, isocoreopsin, monospermoside and chalcones, isomonospermoside, aurones, steroids and flavonoids. Glycoside of the BM contains 5,7-dihydroxy -3,6,4-trimethoxy flavone-7-O-α-L xylopyranosyl (1→3)-O-α-L-arabinopyranosyl-(1→4)-O-β-D galacto pyranoside [14,15].
- **Gum:** Gum contains mucilaginous material, pyrocatechin and tannins [16].
- **Seed:** Oil contains polypeptidase, lypolytic enzymes, proteinase and proteolytic [16]. Palasonin and nitrogenous acidic compounds is present in seeds. Seed also contains isomonospermoside, monospermoside and allophanic acid. Flavone glycoside present in the seeds of BM which possess potential antiviral activity [17]. BM seeds contain fixed oil, mixed fatty acids, and unsaponifiable matter [18].
- **Resin:** Resin contains jalaric esters I, II and laccijalaric esters III, IV α amyrin, β-sitosterone its glucoside and sucrose; lactone-nheneicosanoic acid-δ-lactone [19].
- **Saponin:** Saponin contains butein, butin, butrin, colourless isomeric flavanone and chalcones [20].
- **Leaves:** Leaves contain kino-oil containing oleic, linoleic acid, lignoceric acid and palmitic [21].
- **Stem:** Stems contain 12 dimethyl-8-oxo-octadec-11-enylcyclohexane, Stigmasterol-β-D-glucopyranoside and nonacosanoic acid [22].
- **Bark:** Barks contain gallic acid, kino-tannic acid, pyrocatechin. Barks also contain allophanic acid, butolic acid, shellolic acid, butrin, alanind, palasitrin, cyanidin, histidine, palasimide and miroestrol [21,22]. Isolation from stem bark methanolic extract of BM gives two structurally related methoxyisoflavones; cajanin and isoformononetin [23]. The phytochemical investigation and isolation of the stem bark of BM contain following compounds such as buteaspermin A, buteaspermin B and buteasperminol, medicarpin, cajanin, formonentin, isoformonentin and cladrin [24]. The active constituent obtained from ethyl acetate and petroleum extracts of the stem bark of BM was medicarpin [25].

| Plant Parts | Type of active principles | Example |
|---|---|---|
| Flowers | Triterpene | butrin, isobutrin, coreopsin, sulphurein, isocoreopsin, monospermoside, chalcones, isomonospermoside, steroids. |
| | Glycoside | 5,7-dihydroxy -3,6,4-trimethoxy flavone-7-O-α-L xylopyranosyl (1→3)-O-α-L-arabinopyranosyl-(1→4)-O-β-D galacto pyranoside. |
| Gum | Tannins | Mucilaginous material, pyrocatechin |
| Seed | enzymes | Polypeptidase, lipolytic enzymes, proteinase and proteolytic enzymes |
| Resin | esters | Jalaric esters I, II and laccijalaric esters III, IV α amyrin. |
| Saponin | polyphenols | Chalcones, butein, butin |
| Leaves | Fatty acid | Kino-oil containing oleic, linoleic acid, lignoceric acid. |
| Bark | Amino acids | Allophanic acid, butolic acid, shellolic acid, butrin, alanind, palasitrin, cyanidin, histidine |
| Stem | steroids | Stigmasterol-β-D-glucopyranoside and nonacosanoic acid |

**Table 1:** Various active constituents of *Butea monosperma.*

**Figure 1:** B. *monosperma*

## Pharmacological properties of *B. monosperma*

Various parts of BM possess several pharmacological actions (Table 2). We have segregated multiple medicinal properties of different parts of BM such as leaves, flower, seed, bark and fruits. The actions of various parts of BM are as follows:

### Leaves

- **Anti-filarial:** Aqueous extract of BM significantly inhibited the motility of microfilariae (Brugia malayi). This effect was seen in a dose dependent manner with IC50 value at 83ng/ml [26].

- **Antidiabetic:** Alloxan was used to induce diabetes in male rat. Oral administration of ethanolic extract of BM leaves showed antidiabetic activity. BM extract significantly lowers the blood glucose level and increased the activities of antioxidant enzymes upon treatment at 300mg/kg dose for continuous 45 days, which suggested that BM leaves have significant antioxidant and hypoglycemic effects [27,28].
- **Anti-inflammatory and anti-oxidant:** Different extracts of BM leaves showed anti-inflammatory activity in human red blood cells (HRBC) membrane stabilizing method. The petroleum ether and chloroform extract exhibited significant anti-inflammatory effects whereas hexane, ethyl acetate and ethanol extracts showed moderate antioxidant effects and anti-inflammatory activity [29,30].

| Plants part | Extract | Pharmacological action | References |
|---|---|---|---|
| Leaves | Aqueous | Anti-filarial | 26 |
| | Ethanolic | Antidiabetic, antioxidant | 34 |
| | Petroleum ether, chloroform | Anti-inflammatory, anti-oxidant | 29 |
| Flowers | Aqueous | Anticancer, Hepatoprotective effect | 31 |
| | Petroleum | Anticonvulsant | 32 |
| | Ethanolic | Antihyperglycemic, antioxidant potential | 34 |
| | Methanolic | Anti-inflammatory, antioxidant effects, Anti-dopaminergic activity, Free radical scavenging effect | 36, 40 |
| Seed | Alcoholic | Hormone balancing effect | 43 |
| | Methanolic | Antifertility effect, Anthelmintic effect | 43, 46 |
| | Ethanolic | Anti-hyperglycemic and Anti-hyperlipidemic | 47 |
| Barks | Ethanolic | Anti-diarrhoeal, Wound healing activity, Anti-stress | 52, 41 |
| | Methanolic | Osteogenic and Osteoprotective activity, Anti-inflammatory, Effects on hormone level, Anti-ulcer | 53, 55, 57 |
| Fruits | Methanolic | Hypoglycemic effect | 60 |
| | Pippali rasayana | Antihelminthic effect | 65 |

**Table 2:** Pharmacological action of different parts of *B. monosperma*.

## Flowers

- **Anti-cancer:** Aqueous extract of BM showed anticancer activities by accumulation of cells in $G_1$ phase and inhibiting cell proliferation with significant induction of apoptotic cell death suggesting anticancer properties of BM [31].
- **Anticonvulsant:** Petroleum ether extract of BM has been fractionated with varying polarity such as ethyl acetate, n-hexane and methanol by column chromatography. Fractionated part of petroleum extract of BM exhibited anticonvulsant activity against seizures induced by maximum electroshock (MES), Pentylenetetrazole (PTZ) and lithiumsulfate- pilocarpine nitrate. Additionally, triterpene present in BM exhibited anti-depressant effect [32].

## Antihyperglycemic and antioxidant potential

50% ethanolic extract of BM flowers possess significant antidiabetic activity against alloxan-induced diabetes in wistar rats The ethanolic extract of BM showed antidiabetic activity by reducing the level of total cholesterol, triglyceride and very low-density lipoprotein cholesterol [33]. The oxidative harm in the various organ like pancreas, liver and kidneys of diabetic mice shown by a remarkable elevation in thiobarbituric acid level and a distinct diminution in glutathione content was abolished by ethanolic extract of BM. Anti-diabetic and anti-oxidant activity of BM may be attributed due to the presence of flavonoids, saponins and sterols [34].

## Anti-inflammatory and antioxidant effects

Methanolic extract of BM (600 mg/kg and 800 mg/kg) showed anti-inflammatory effect which was dose dependent. It inhibited the paw edema and granuloma in carrageenan induced paw edema and cotton pellet granuloma model in rats [35]. This may be due to the presence of various polyphenols like butrin, isobutrin, isocoreopsin, and butein in BM [36].

### Antimycobacterial activity

BM flowers contain bioactive flavonoids such as dihydromonospermoside, dihydrochalcone, monospermoside, isoliquiritigenin and butein showed antimycobacterial activity [37]. The study revealed its antifungal activity against various fungal species [38].

### Antimicrobial activity

5,7-dihydroxy -3,6,4-trimethoxy flavone-7-O-α-L xylopyranosyl (1→3)-O-α-L-arabinopyranosyl-(1→4)-O-β-D galactopyranoside showed antimicrobial activity. Seed oil of BM possess antimicrobial potential against pathogenic bacteria and fungi. So the oil has fungicidal and bactericidal properties [39].

### Antidopaminergic activity

Isoflavone isolated methanolic extract of BM which showed antidopaminergic activity and inhibit the foot shock-induced aggression in rats and potentiated haloperidol-induced catalepsy in a dose dependent manner [40].

### Hepatoprotective effect

Hepatoprotective effect of flowers of BM aqueous extract (200, 400, 800 mg/kg, p.o.) was examined against $CCl_4$ (1.5 ml/kg i.p.) induced hepatotoxicity. $CCl_4$ has the ability to cause liver cirrhosis and necrosis. Therefore $CCl_4$ administration significantly changed number of biochemical parameters such as albumin, protein, hepatic lipid peroxidation, reduced glutathione and total protein levels. It was witnessed that BM has restored all the altered biochemical parameters including histopathological alterations in dose dependent manner [41].

### Free radical scavenging effect

The methanolic extract of flower part of BM showed free radical scavenging effect which was evaluated followed by 2,2 diphenyl-1-picrylhydrazyl (DPPH) radical, superoxide dismutase (SOD) assay. In addition, inhibition of erthrocytes hemolysis was also evaluated by 2, 2' azo-bis (amid inopropane) dihydrochloride (AAPH) antioxidant assay. These effect may be due to presence of higher phenolic contents in the extract [42].

### Seeds

- **Hormone balancing effect:** Alcoholic extract of BM possess antiestrogenic effect and anti-implantation activities. However, the estrogenic activity is due to the presence of active constituents like Butin which also exhibits male contraceptive properties. Methanolic extracts of BM seed also possess antifertility effect and uterine peroxidase activities [43].

- **Anti-implantation activity:** Butin is an active compound of BM. Oral administration of Butin at the doses of 5, 10 and 20 mg/rat showed anti-implantation activity. A dose dependent response was seen during termination of pregnancy. Further, at lower doses, a decrease in the quantity of implantation sites was also noticed. Butin has estrogenic activity at comparable anticonceptive doses observed in ovariectomized young female rats but was devoid of antiestrogenic activity [44].

- **Anthelmintic effect:** The methanolic extract of BM seeds possess significant anthelmintic activity against *Caenorhabditis elegans* [45]. The anthelmintic activity against *Trichostrongylid nematodes* in sheep strongly corroborate this finding. The methanolic extract of crude powder obtained from the seeds of BM (1, 2 and 3mg/kg) showed anthelmintic effect. Time and dose dependency was noticed [46]. In addition extract of same solvent also possess significant anthelmintic activity.

- **Anti-hyperglycemic and Anti-hyperlipidemic:** The ethanolic extract obtained from BM seeds possess antidiabetic, anti-hyperlipidemic and antiperoxidative effects. The ethanolic extract treated for four weeks exhibit significant antihyperglycemic effect with improved glucose tolerance in non-insulin dependent diabetic (NIDDM) rats [47].

- **Antiviral:** Flavone glycoside isolated from the seeds possess potential antiviral properties [17].

- **Antimicrobial activity:** BM seed oil showed a significant fungicidal and bactericidal effect *in vitro* which may be due to the presence of active constituents like medicarpin [48].

- **Anti-inflammatory:** Cotton pellet induced granuloma and carrageenin-induced paw oedema method were used for the evaluation of antiinflammatory activity. The study revealed that on oral administration of BM seed extract possess significant anti-inflammatory effects which may be due to presence of fixed oil, mixed fatty acids, and unsaponifiable matter present in the BM extract [49].

### Barks

- **Anti-diarrhoeal:** Ethanolic extract of bark and stem parts of BM have potential anti-diarrhoeal activity against castor oil induced diarrhea and PGE2 induced enteropooling in rats. Oral administration of charcoal meal along with BM extract showed remarkable decrease in gastrointestinal motility [50].

- **Wound healing activity:** Ethanolic extract of BM bark possesses wound healing effect in rats [51]. It accelerated the wound healing effect when administered topically on full excision wounds made on the back of rats. The ethanolic extract of BM increased collagen synthesis as well as cellular proliferation at the wound infected area. The extract increased the wound contraction and decreased epithelialization time in excision wound model, increased the hydroxyproline content, granulation tissue weight and tensile strength of the incision wound area [52].

- **Osteogenic and Osteoprotective activity:** Cajanin isolated from stem bark methanolic extract of BM possesses

differentiation-promoting as well as powerful mitogenic effects on osteoblasts. However, isoformononetin was found to have potent anti-apoptotic effect and osteoblast differentiation promoting effects [53]. Stem bark extract of BM possesses osteogenic and osteoprotective properties [23,54].

- **Anti-inflammatory:** The methanolic extract of the stem bark of BM showed analgesic and anti-inflammatory action against acetic acid induced writhing, hot plate test model and carrageenan induced paw edema in a dose dependent manner comparable to diclofenac sodium [55].
- **Anti-stress:** Water soluble part of ethanolic extract of BM showed antistress effect. Ethanolic extract of BM decreases the elevated level of plasma corticosterone and brain serotonin and this anti-stress effect was comparable to that of diazepam [56].
- **Effects on hormone level:** Administration of Stigmasterol (2.6 mg/kg), isolated from the bark of methanolic extract of BM for 20 days in the experimental animals reduced serum triiodothyronine, thyroxin, and glucose concentrations with a concomitant increase in insulin. Moreover, there was significant increase in the level of superoxide dismutase, glutathione and catalase as well as decrease in hepatic lipid peroxidation upon the treatment suggesting promising thyroid inhibitory and hypoglycemic effects of Stigmasterol [57].
- **Anti-fungal:** Medicarpin had greater antifungal activity than the standard fungicide Benlate against *Cladosporium cladosporioides* [58].
- **Anti-ulcer:** Methanolic extract of BM bark at 500mg/kg showed 79.30 and 82.20% healing against ethanol and aspirin induced gastric ulcerations respectively signifying free radical scavenging properties of the extract for anti-ulcer effect [59].

### Fruits

**Hypoglycemic effect:** BM methanolic extract showed significant decrease in blood urine sugar, plasma glycoprotein and glucose levels upon treatment (3g/30ml of water for 30 days). Moreover, there was reduction in lipid profile and the restoration of activities of liver enzymes suggesting potential anti-diabetic effects of BM fruit extract [60]. The study revealed that herbal formulations consisting of three plant parts; Piper betel, *Butea monosperma* and Trigonella foenum graecum have anti-diabetic potential in control and alloxan induced diabetic rats [61,62].

**Antimicrobial and anti-fungal:** Different fractions obtained from BM possesses significant antimicrobial effects across various bacterial and fungal species [39,63,64].

**Antihelminthic effect:** Pippali rasayana containing the extract of BM for the evaluation of immuno-stimulatory and antigiardial activity against Giardia lamblia and they has observed about 98% recovery from the infection. However, *in vitro* study suggested that rasayana had no homicide effect over the parasite which showed significant activation of macropahges which is an indication of elevated level of macrophages migration index (MMI). BM extract (900mg/kg) also exhibited phagocytic activity. In addition, they administered Pippali Rasayana orally 1g, for 15 days duration and they noticed that here was an absolute absence of Giardia lamblia form the patients (25 treated, 25 placebo controls) [65]. The active principles obtained from this plant parts possess various biological activity have been tabulated in brief (See Table. 2).

## Conclusion

Various bioactivity studies of *B. monosperma* plant derivatives are at the preliminary level requiring further studies to delineate the mechanism of actions. Only few studies shed light in the mechanism of actions in detail. This review provides an outlook on various phytochemistry and pharmacological aspects that need to be done to carry forward the available information in developing suitable clinical therapeutics out of *B. monosperma* plant.

## Conflict of Interest

We declared that we have no conflict of interest.

## Acknowledgement

This work was financially supported in form of fellowship by the Indian Council of Medical Research (ICMR), New Delhi, India (45/5/2013/BMS/TRM).

## Bibliography

1. Shah GM., *et al*. "Observations on antifertility and abortifacient herbal drugs". *African Journal of Biotechnology* 8.9 (2009): 1959-1964.
2. Burli DA and Khade AB. "A comprehensive review on Butea monosperma (Lam.) Kuntze". *Pharmacognosy Reviews* 1.2 (2007): 333-337.
3. Upadhyay B., *et al*. "Ethno-veterinary uses and informants consensus factor of medicinal plants of Sariska region, Rajasthan, India". *Journal of Ethnopharmacology* 133.1 (2011): 14-25.
4. Gaikwad SR., *et al*. "Study of zooplankton emergence pattern and resting egg diversity of recently dried waterbodies in North Maharashtra Region". *Journal of Environmental Biology* 29.3 (2008): 353.
5. Katewa SS., *et al*. "Folk herbal medicines from tribal area of Rajasthan, India". *Journal of Ethnopharmacology* 92.1 (2004): 41-46.
6. Aher RK., *et al*. "Survey of medicinal plants from areas of Ahmednagar District (Maharashtra State)". *Asian Journal of Microbiology Biotechnology and Environmental Sciences* 6 (2004): 83-86.

7. Sikarwar RL and Kumar V. "Ethnoveterinary knowledge and practices prevalent among the tribals of central India". *Journal of Natural Remedies* 5.2 (2005): 147-152.

8. Tambekar DH and Khante BS. "Antibacterial properties of traditionally used medicinal plants for enteric infections by adivasi's (Bhumka) in Melghat forest (Amravati district)". *International Journal of Pharmaceutical Sciences and Research* 1 (2010): 120-128.

9. Jain A., *et al*. "Folk herbal medicines used in birth control and sexual diseases by tribals of southern Rajasthan, India'. *Journal of Ethnopharmacology* 90.1 (2004): 171-177.

10. Srivastava M., *et al*. "Pharmacognostical evaluation of seed of Butea monosperma Kuntze*". Natural Product Sciences* 8.3 (2002): 83-89.

11. Neelam KN., *et al*. "A study on Palash (Butea Monosperma Lam. Kuntz.) with special reference to its role in Madhumeha (Diabetes Mellitus Type 2)". *Journal of Medicinal Plants* 5 (2017): 204-206.

12. Husain M. "Rasavaha srotas and their physiological importance: an ayurveda review". *Journal of Drug Delivery and Therapeutics* 8.5 (2018): 115-117.

13. Galib G., *et al*. "Tribulus terrestris Linn.: A phyto-pharmacological review". *Journal of Ayurveda and Holistic Medicine (JAHM) 1*.3 (2013): 37-43.

14. Kasture VS., *et al*. "Anticonvulsive activity of Butea monosperma flowers in laboratory animals". *Pharmacology Biochemistry and Behavior* 72.4 (2002): 965-972.

15. Surin WR and Ananthaswamy K. "Recent advances on the pharmacological profile of Butea monosperma". *GERF Bulletin of Biosciences* 2 (2011): 33-40.

16. Shah KN., *et al*. "A phyto-pharmacological overview on Jewel Weed". *Journal of Applied Pharmaceutical Science* 7.8 (2017): 246-252.

17. Yadava RN and Tiwari L. "Note: A potential antiviral flavone glycoside from the seeds of Butea monosperma O. Kuntze". *Journal of Asian Natural Products Research* 7.2 (2005): 185-188.

18. Gunakunru A., *et al*. "Chemical investigations and anti-inflammatory activity of fixed oil of Butea monosperma seeds". *Natural Product Sciences* 10.2 (2004): 55-58.

19. Singh AN., *et al*. "Chemistry of lac resin—VI: Components of soft resin". *Tetrahedron* 30.7 (1974): 867-874.

20. Lohitha P., *et al*. "Phytochemical screening and in vitro antimicrobial activity of butea monosperma (l) bark ethanolic and aqueous extract". *International Journal of Pharmaceutical Sciences and Research* 1.10 (2010): 150.

21. Indurwade NH., *et al*. "Herbal plants with aphrodisiac activity". *Indian Drugs* 42.2 (2005): 67-72

22. Burli DA., *et al*. "A comprehensive review on Butea monosperma (Lam.) Kuntze". *Pharmacognosy Reviews* 1.2 (2007): 333-337.

23. Pandey R., *et al*. "Total extract and standardized fraction from the stem bark of Butea monosperma have osteoprotective action: evidence for the nonestrogenic osteogenic effect of the standardized fraction". *Menopause* 17.3 (2010): 602-610.

24. Tyagi AM., *et al*. "Medicarpin inhibits osteoclastogenesis and has nonestrogenic bone conserving effect in ovariectomized mice". *Molecular and Cellular Endocrinology* 1.2 (2010): 101-109.

25. Gupta P., *et al*. "Phytochemical and pharmacological review on Butea monosperma (Palash)". *International Journal of Agronomy and Plant Production* 3.7 (2012): 255-258.

26. Sahare KN., *et al*. "In vitro effect of four herbal plants on the motility of Brugia malayi microfilariae". *Indian Journal of Medical Research* 127.5 (2008): 467.

27. More BH., *et al*. "Ethnobotany and Ethanopharmacology of Butea Monosperma (Lam) Kuntze-A Compressive Review". *American Journal of Pharmtech Research* 2. (2012): 138-159.

28. Sharma AK and Deshwal N. "An overview: On phytochemical and pharmacological studies of Butea monosperma". *International Journal of Pharmaceutical Sciences and Research* 3. (2011): 864-867.

29. Borkar VS., *et al*. "Evaluation of in vitro anti-inflammatory activity of leaves of Butea monosperma". *Indian Drugs* 47.6 (2010): 62-63.

30. Borkar VS., *et al*. "In vitro evaluation of Butea monosperma Lam. for antioxidant activity". *Oriental Journal of Chemistry* 24. (2008): 753-755.

31. Choedon T., *et al*. "Chemopreventive and anti-cancer properties of the aqueous extract of flowers of Butea monosperma". *Journal of Ethnopharmacology* 129.2 (2010): 208-213.

32. Kasture VS., *et al*. "Anticonvulsive activity of Albizzia lebbeck, Hibiscus rosa sinesis and Butea monosperma in experimental animals'. *Journal of Ethnopharmacology* 71.2 (2000): 65-75.

33. Somani R., *et al*. "Antidiabetic potential of Butea monosperma in rats". *Fitoterapia* 77.2 (2006): 86-90.

34. Sharma N., *et al*. "Antihyperglycemic, antihyperlipidemic and antioxidative potential of Prosopis cineraria bark". *Indian Journal of Clinical Biochemistry* 25.2 (2010): 193-200.

35. Shahavi VM and Desai SK. "Anti-inflammatory activity of Butea monosperma flowers". *Fitoterapia* 79.2 (2008): 82-85.

36. Rasheed Z., *et al*. "Butrin, isobutrin, and butein from medicinal plant Butea monosperma selectively inhibit nuclear factor-κB in activated human mast cells: Suppression of tumor necrosis factor-α, interleukin (IL)-6, and IL-8". *Journal of Pharmacology and Experimental Therapeutics* 333. 2 (2010): 354-363.

37. Chokchaisiri R., *et al*. "Bioactive flavonoids of the flowers of Butea monosperma". *Chemical and Pharmaceutical Bulletin* 57.4 (2009): 428-432.

38. Yadava RN and Tiwari L. "New antifungal flavone glycoside from Butea monosperma O. Kuntze". *Journal of Enzyme Inhibition and Medicinal Chemistry* 22.4 (2007): 497-500.

39. Gaurav SS., *et al*. "Antimicrobial activity of Butea monosperma Lam. Gum". *Iranian Journal of Pharmacology and Therapeutics* 7.1 (2008): 21.

40. Velis H., *et al*. "Antidopaminergic activity of isoflavone isolated from Butea monosperma flowers". *Planta Medica* 1.1 (2008): 159-168.

41. Sharma N and Shukla S. "Hepatoprotective potential of aqueous extract of Butea monosperma against CCl4 induced damage in rats". *Experimental and Toxicologic Pathology* 63.7.8 (2011): 671-676.

42. Hasan SR., *et al*. "DPPH free radical scavenging activity of some Bangladeshi medicinal plants". *Journal of Medicinal Plants Research* 3.11 (2009): 875-879.

43. Tiwari P and Sahu PK. "Plant's altering hormonal milieu: A review". *Asian Pacific Journal of Reproduction* 6.2 (2017): 49-53.

44. Rana F and Avijit M. "Review on Butea monosperma". *International Journal of Research in Pharmacy and Chemistry* 2. (2012): 1035-1039.

45. Prashanth D., *et al*. "Anthelmintic activity of Butea monosperma". *Fitoterapia* 72.4 (2001): 421-422.

46. Iqbal Z., *et al*. "In vivo anthelmintic activity of Butea monosperma against Trichostrongylid nematodes in sheep". *Fitoterapia* 77.2 (2006): 137-140.

47. Bavarva JH., *et al*. "Preliminary study on antihyperglycemic and antihyperlipaemic effects of Butea monosperma in NIDDM rats". *Fitoterapia* 79.5 (2008): 328-331.

48. Sindhia VR and Bairwa R. "Plant review: Butea monosperma". *International Journal of Pharmaceutical and Clinical Research* 2.2 (2010): 90-94.

49. Gunakunru A., *et al*. "Chemical investigations and anti-inflammatory activity of fixed oil of Butea monosperma seeds". *Natural Product Sciences* 10.2 (2004): 55-58.

50. Gunakkunru A., *et al*. "Anti-diarrhoeal activity of Butea monosperma in experimental animals". *Journal of Ethnopharmacology* 98.3 (2005): 241-244.

51. Sumitra M., *et al*. "Efficacy of Butea monosperma on dermal wound healing in rats". *The international Journal of Biochemistry and Cell Biology* 37.3 (2005): 566-573.

52. Gavimath CC., *et al*. "Evaluation of woud healig activity of butea monosperma lam. Extracts on rats". *Pharmacologyonline* 2. (2009): 203-216.

53. Bhargavan B., *et al*. "Methoxylated isoflavones, cajanin and isoformononetin, have non-estrogenic bone forming effect via differential mitogen activated protein kinase (MAPK) signaling". *Journal of Cellular Biochemistry* 108.2 (2009): 388-399.

54. Maurya R., *et al*. "Osteogenic activity of constituents from Butea monosperma". *Bioorganic and Medicinal Chemistry Letters 19*.3 (2009): 610-613.

55. William CM and Krishna Mohan G. "Antiinflammatory and analgesic activity of Butea monosperma (Lam) stem bark in experimental animals". *Pharmacologyonline* 2. (2007): 88-94.

56. Bhatwadekar AD., *et al*. "Antistress activity of Butea monosperma flowers". *Indian Journal of Pharmacology* 31.2 (1999): 153.

57. Panda S., *et al*. "Thyroid inhibitory, antiperoxidative and hypoglycemic effects of stigmasterol isolated from Butea monosperma". *Fitoterapia* 80.2 (2009): 123-126.

58. Bandara BR., *et al*. "An antifungal constituent from the stem bark of Butea monosperma". *Journal of Ethnopharmacology* 25.1 (1989): 73-75.

59. Surin WR and Ananthaswamy K. "Recent advances on the pharmacological profile of Butea monosperma'. *GERF Bulletin of Biosciences* 2. (2011): 33-40.

60. Naeem F and Khan SH. "Evaluation of Hypoglycemic and Hypolipidemic Activity of Butea monosperma Fruit in Diabetic Human Subjects". *Turkish Journal of Biology* 34. (2010): 189-197.

61. Thorat R., *et al*. "Antidiabetic activity of HF on alloxan induced diabetic rats". *Pharmacologyonline*. 4.2 (2010): 1089-1099.

62. Permender R., *et al*. "Antidiabetic potential of Fabaceae family: An overview". *Current Nutrition and Food Science* 6.3 (2010): 161-175.

63. Shukla YN., *et al*. "Antimicrobial activity of Butea monosperma". *Indian Drugs* 38. (2001): 49-50.

64. Sahu MC and Padhy RN. "In vitro antibacterial potency of Butea monosperma Lam. against 12 clinically isolated multidrug resistant bacteria". *Asian Pacific Journal of Tropical Disease* 3.3 (2013): 217-226.

65. Mendhe BB., *et al*. "Evaluation of Anthelmintic activity of leaf extracts of Butea Monosperma". *International Journal of Pharmaceutical Sciences and Research* 1.3 (2011): 69-72.

**Volume 3 Issue 4 April 2019**