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By

S. Arshad Hasan Rizvi, Amber Hasan, Mohd Zahid Rizvi,
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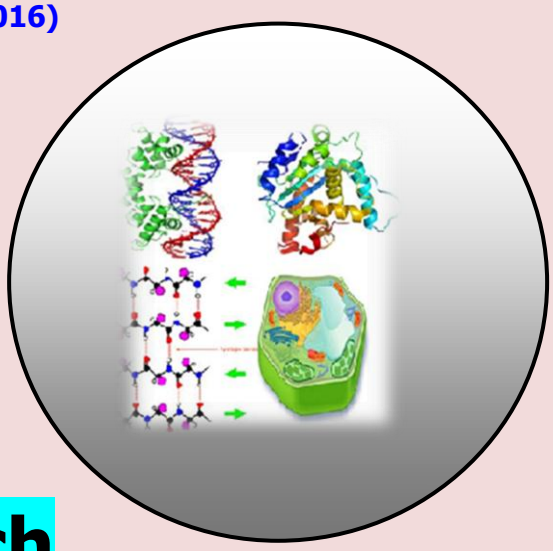
ISSN 2319-3077 Online/Electronic
ISSN 0970-4973 Print

UGC Approved Journal No. 62923
MCI Validated Journal
Index Copernicus International Value
IC Value of Journal 82.43 Poland, Europe (2016)
Journal Impact Factor: 4.275
Global Impact factor of Journal: 0.876
Scientific Journals Impact Factor: 3.285
InfoBase Impact Factor: 3.66

J. Biol. Chem. Research
Volume 35 (2) 2018 Pages No. 1055-1065



Journal of Biological and Chemical Research

An International Peer Reviewed / Referred Journal of Life Sciences and Chemistry

Indexed, Abstracted and Cited in various International and National Scientific Databases

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 35, No. 2: 1055-1065, 2018
(An International Peer Reviewed / Refereed Journal of Life Sciences and Chemistry)
Ms 35/02/201/2018

ISSN 2319-3077 (Online/Electronic)
ISSN 0970-4973 (Print)



Dr. A. Hasan Dr. S.A.H. Rizvi



S. Fatima Rizvi Dr. R. Nashine

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RESEARCH PAPER

Received: 24/11/2018 Revised: 28/12/2018 Accepted: 29/12/2018

Occurrence of Bioactive Secondary Metabolites in *Butea monosperma* (Lam.) Taub.: An Overview

S. Arshad Hasan Rizvi, Amber Hasan, Mohd Zahid Rizvi,
***Shareen Fatima Rizvi and **Reena Nashine**
Department of Botany, Shia P.G. College, Lucknow, U.P., India
***Department of Zoology, I.T. College, Lucknow, U.P., India**
****Department of Chemistry, Chouksey Engineering College, Bilaspur, Chhattisgarh, India**

ABSTRACT

Butea monosperma (Lam.) Taub. belongs to family fabaeceae. It is widely distributed in India and South Asian countries. It is commonly called palash tree and popularly known as flame of forest. This plant is very electively used in traditional medicines in several countries. Biochemical analysis showed many bioactive secondary metabolites occurring in this plant for example, Buterin, iso-butrin, butin coreopsin, α- amyrin, β-cytosterol, gallic acid and medicaprin which are very useful for cure of several ailments. Recent studies of various parts like leaves, bark, flowers and seed extract contained the active biochemical principles which can cure. Disorders like diabetes, cancer, osteoporosis, hepatoprotective properties. The detail experimental investigations were carried out on various animal models in-vitro, in-vivo and in clinical studies by different workers. The present overview provides sufficient information about therapeutic agents occurring in different parts of this plant displayed pharmacological properties.

Keywords: Butea monosperma, Anti-diabetic, Anti-Cancer, Secondary Metabolites, Hepato-protective, Butrin and Medicarpin.

INTRODUCTION

B. monopserma (Lam.) Taub. is a native plant of tropical and sub-tropical parts of India, it is also distributed in other countries like, Bangladesh, Nepal, Srilanka, Mayanmar, Thailand, Malaysia and Vietnam.

Butea is commonly called 'flame of the forest' belongs to the family fabaceae (Sutariya and Saraf, 2015, Yadav et al., 2015). Locally this plant is commonly known as Palash or Palas, Muthuga etc. The crude extract of this plant was reported to has antifungal, anti-inflammatory, antibacterial, hypoglycemic, anticonceptive, antiulcer, osteoprotective and hepatoprotective in nature. It also has anticancer astringent, uretic, tonic and aphrodisiac properties. The wide spread uses of *Butea* in traditional system of medicine has resulted the chemical analysis for their bioactive secondary metabolites components (Surin and Anantha Swami, 2011, Bud Gujjar et al., 2018, Srivastava et al., 2013).

A Phyto-chemical constituent of this plant was analyzed as butrin, butein, terpenes such as lupeol and lupenone, flavonoids and steroids. Flowers contain coreopsin, isocoreopsin, sulphurein, monospermoside and isomonospermoside were identified (Das et al., 2014, Patel et al., 2017).

Taxonomy

This plant holds significant medicinal and economical value. It is medium sized deciduous tree, 5-15 m tall, stem is rough due to grayish – brown exudates, branchlets densely pubescent.

Leaves with long petioles, trifoliate, petiole is slender, cylindrical, thickened at base, stipules, small linear or lanceolate, leaflets are dark brown, flowers arranged in Racemose inflorescence which is 15-16 cm in length and 3 flowers are seen on nodes. The axis is olive green and velvety. Flowers are used as vegetable by tribals. It is also used in preparation of dye for coloring garments (Plate 1).

Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Order : Fabales
Family: Fabaceae
Genus : *Butea*
Species : *monosperma* (Lam.) Taub.

Plant can tolerate extreme summer and dry conditions. Flowers are odourless, reddish in color and flowering takes place during spring. Flowers are large bright produced in rigid racemose inflorescence. Fruits are flate stalked legumes, young pods have a lot of hairs as velvety cover. Bark is fiberous, bluish-gray to light brown in colour when injured exudes a kind of red juice known as *Butea* gum.

Plant parts used are barks, leaves flower, seed and gum (Khan, 2010, Burli and Khade, 2007). It was observed that extracts prepared in aqueous, methanol or ethanols are mainly useful as anti-helminthic, appetizer and laxative (Prasad et al., 2006). Moreover it is used for ethno-veterinary medicines and traditionally in management of many diseases in various parts of India and South Asia (Upadhyay et al., 2011, Mridula et al., 2004, Katewa et al., 2004, Aher et al., 2004, Jain et al., 2004).

Moreover it has the property of reducing Kaph and Vath (Srivastava et al., 2013). It is important to note that Bud Gujjar et al., in 2018 reported the anti-proliferative activity of crude extract and the different fractions of *B. monosperma* were also used against lungs cancer cell line.

***Butea monopserma* Flower**

***Butea monopserma* Leaf** ***Butea monosperma* Fruit**

***Butea monosperma* Seeds**

Plate 1. Habit of *B. monosperma.*

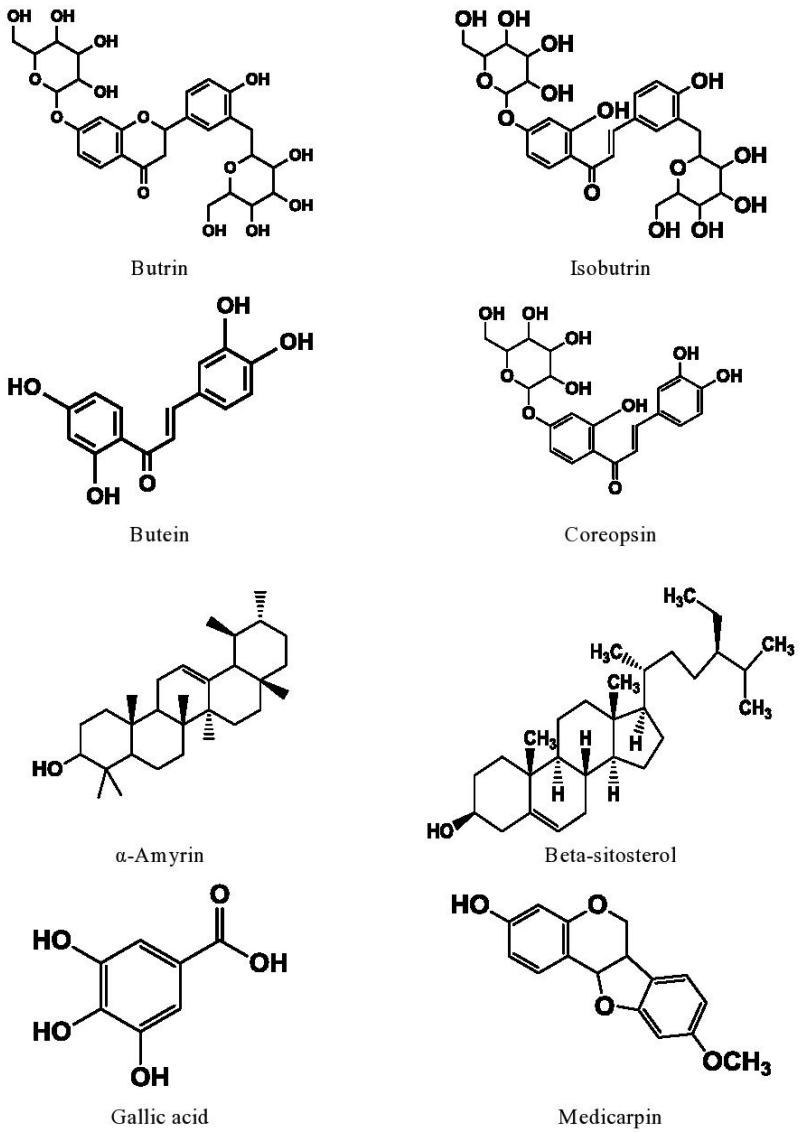

Figure 1. Chemical structure of the Bio-active secondary metabolites of *B. monosperma.*

Phyto-chemical Constituents

The biochemical analysis of different parts of *B. monosperma* plants.

Flower: It contains triterpene, flavonoids butein, butin isobutrin, coreopsin, isocoreopsin (Butin-7-glucoside), sulphustin, monospermoside (butein-3-e-D-glucoside) and isomono spermoside, chalcones, aurones, isobutyine, palasitrin, 3,4,7- trihydroxyflavone (Gupta et al., 1970) Myricyl alcohol, stearic, palmitic, arachidic and lignoceric acids (Murti et al., 1940) glucose, fructose, histidine, aspartic acid, alanine and phenylalanine (Saxena et al., 1998) Gum - Tannins, mucilaginous material, pyrocatechin. Seed - Oil (yellow, tasteless), proteolytic and lypolytic enzymes, plant proteinase and polypeptidase (Similar to yeast trypsin). A nitrogenous acidic compound, along with palasonin is present in seeds.

It also contains monospermoside (butein3-e-D-glucoside) and somonospermoside. Allophanic acid, several flavonoids (5, 6, 7, 4'-tetrahydroxy-8-methoxyisoflavone 6-O-rhamnopyranoside (Saxena et al., 1998). Butin (37)α-Amyrin, β- sitosterol, β-sitosterol-β-Dglucoside, sucrose, Fatty acids such as myristic, palmitic, stearic, arachidic, behenic, lignoceric, oleic, linoleic and linolenicxv Monospermin (Mehta et al., 1981) and an acid imide (Chandra et al., 1977). 15-Hydroxypentacosanoic acid nheneicosanoic acid δ- lactone (Barua et al., 1970). 10, 16-dihydroxy hexadecanoic acid (Chatterjea et al., 1976) Phosphatidylcholine, phosphatidyl ethanolamine and phosphatidylinositol (Prasad et al., 1987) Root- The root of *Butea monosperma* contains glucose, glycine, a glycoside (aglycon) and an aromatic hydroxy compound (Tandon et al., 1969). Stem- 3-Z-hydroxyeuph-25-ene and 2,14- dihydroxy- 11,12-dimethyl-8-oxo-octadec-11- enylcyclohexane (Guha et al., 2017) Stigmasterol-e-Dgluco pyranoside and nonacosanoic acid (Mishra et al., 2000) Flavonoid 8-C-prenylquercetin 7,4'-di-Omethyl-3- O-α- L-rhamnopyranosyl (1-4)-α- Lrhamnopyranoside (Yadav et al., 1998). 3-hydroxy-9~ methoxypterocarpan [(-)-medicarpin]. Lupenone, lupeol and sitosterol. Two iso flavones 5-methoxy genistein and prunetin (Bandara et al. 2002). In addition to stigmasterol-3-α-Larabinopyranoside, four compounds isolated from the stem of *Butea monosperma* have been characterized as 3- methoxy-8, 9-methylene dioxypterocarp – 6 - ene, 21- methylene – 22 -hydroxy-24-oxooctacosanoic acid Me ester, 4 – pentacosanylphenol and pentacosanyl- β-Dglucopyranoside (Shukla et al., 2002). Bark - Kino-tannic acid, Gallic acid, pyrocatechin (Nadkarni et al., 2002). Leaves - Glucoside Kino-oil containing oleic and linoleic acid, palmitic and lignoceric acid (Murti et al., 1940). Resin - Jalaric esters I, II and laccijalaric esters III, IV., Z-amyrin, esitosterone and its glucoside, sucrose, lactonenheneicosanoic acid-{-lactone (Rastogi and Mehrotra, 1979) (Figure 1).

Pharmacological effect of *B. monopsperma* leaf extract

Recent advances on the pharamacological profile of *B. monosperma* was described was described earlier (Surin and Anthaswamy, 2011, Sutariya and Saraf, 2015, Yadav et al., 2015, Patel et al., 2017, Prashar and Dhamtja, 2011) (Table 1).

1. Anti-filarial Effect

Sahare et al., 2012 reported the aqueous extract of leaves and roots significantly inhibited the motality of microfilariae under in vitro conditions IC50 value suggesting anti-filarial effects. The methanolic and hexane-ethanolic extracts of leaves showed significant antifilarial activity in terms of motality inhibition assay and MTT – reduction assay.

2. Anti-diabetic Effect

Sharma and Garg, 2009 evaluated the ethanolic extract of *B. monopserma* leaf on alloxan induced diabetes model in male rats. The reduced fasting blood glucose over increase the activity of antioxidant enzyme upon treatment. Thus, a significant antioxidant and hypoglycemic effect have been recorded.

3. Anti-inflammatory and Antioxidant Effect

Surin and Ananthaswami, 2011 have evaluated ethanolic petroleum ether, ethyacetate, chloroform hexane extract of *B. monosperma* leaf for anti-inflammatory activity by using human RBC membrane stability methods. The petroleum ether and chloroform extract showed significant anti-inflament effect holween the over extract showed moderate activity.

4. Anticancer and Anti-proliferative Effect

The anticancer effect have been evaluated in aqueous extract of dried however of *B. monosperma*. The anti-proliferative and proapoptic and anticancer activity in a cancer model was recorded, it was found to inhibit cell proliferative and accumulation in GI phase during cell decision with significant induction of apoptotic cell death suggesting and proving anti-cancer property. However the studies were conduct through oral administration of extract in transgenic mice. Bud Gujjar et al., 2018 studies anti-proliferative activity of crude extract and in different fractions of *B. monosperma* against lung cancer cell line. The methanolic extract was assayed for superoxide. Scavenging of activity and metal cheating assay. DPPH and MTT assay were also implied. MTT assay was performed on A-549 human lung cancerous all and chick embryo fibrolous cells were used as control cells. Result indicated that at LD-50 conc were very promising.

5. Antimicrobial Activity

Shukla et al., 2001 have evaluated the bioactive flavonoids like dihydro chalcon and dihydro mono spermocy to obtain from flowers along with *Butea monospermacyte* and iso-liquiritigemin and showed antimicrobial activity. However Sutariya and Saraf, 2015 have reported antifungal activity, flower extract is effective again *Psedumonas aeruginosa*, *Bacillus syrus* and *Staphylococcus aerus* (Tambekar and Saratkar, 2005, Vasu et al., 2010).

6. Hepatoprotective

The aqueous extract of flower restored serum transaminases hepatic lipid peroxidation reduced gluthatione and total protein level against CCLY induced liver injury (Sgarma et al., 2011). The methanolic extract of stem *B. monosperma* showed significant hepatprotective activity and free radical damage to the body (Satish et al., 2011, Tiwari et al., 2011).

7. Nephroprotective Activity

Ethanolic extract of *B. monosperma* flowers significantly affect the levels serum cretnin, blood urea and nitrogen. It also significantly reduces protein urea dislipidmia and restored renal function (Sutariya et al., 2015).

8. Wound Healing

The ethanolic extract of stem displayed wound healing property in experimental animals (Gavynath et al., 2009). The falavanoid fraction of stem barm also showed wound healing property (Muralidhar et al., 2013).

9. Contraceptive Activity

Butin isolated from seed of this plant possess anticonceptive activity in pregnant rats (Bhargawa, 1986), the administration of seed powder caused disintegration of ova and ovaries and most of the policies remain in immature state (Shah et al., 2009, Gupta et al., 2010).

10. Anti-Stress Activity

Water soluble portion of ethanolic extract of this plant reduced stress by evaluation of serotonin and corticosterone level in brain which is comparable with dizapam (Bhatwadkar et al., 1995).

11. Osteogenic Activity

The content medicarpin, cajanin, formonintin, isoformation and cladrin isolated from stem bark of this plant shown promising osteogenic activity as it is bone mineral density (BMD) (Bhargawan et al., 2001).

12. Anti-Diarrheal

The ethanolic extract of stem bark showed antiprotozoal activity and cure diarrhea by reducing gastrointestinal motality and inhibited protozoans in alimentary canal.

Table 1. Bioactive Principles of Various Plant Parts from *B. monosperma* and their Medicinal Effects.

S. No.	Plant part and Preparation	Medicinal Effect	Active Principle	References
1.	Aqueous extract of seeds	Antifilariasis effect	-	Surin and Ananthaswami, 2011
2.	Ethanolic extract	Antidiabetic Effect	-	Fageria and Rao, 2015
3.	Methanolic extract	Anti-inflammatory	-	Sharma and Garg, 2009 a and b
4.	Aqueous Extract of flower	Antioxidant activity	-	Fageria and Rao, 2015
5.	Aqueous extract of flower	Chemopreventive and and-cancer	-	Badgujar et al., 2018
6.	Active constituents from seeds	Anti-fungal effects	5,7-dihydroxy-3,6,4-trimethoxyflavone-7-o-alphaL-arbinopyr-anosyl-(l-->4)o-beta-D-galactopyranoside	Shukla et al., 2001
7.	Active constituents from seeds	Anti-viral effect	5,7-dihydroxy-3,6,7-trimethoxy-flavone-5-0-beta-D-xylopyranosyc-(1>4)-0-beta-D-glucopyranside	Vasu and Charya, 2010
8.	Methanolic extract	Hepatoprotective	Isobutrin Butrin	Satish et al., 2011, Tiwari et al., 2011, Sharma and Shukla, 2011
9.	Ethanolic extract of flowers	Nephroprotective	-	Sutariya et al., 2015
10.	Alcoholic bark extract	Wound healing	-	Muralidhar et al., 2013, Gavimath et al. 2009

Table 1 contd.

11.	Seed powder	Contraceptic effect	Butin	Jain et al., 2004, Shah et al., 2009
12.	Stem bark	Oesteogenic activity	Medicarpin, cajanin, Formonentin, isoformonentin, cladrin	-
13.	Ethanolic extract of bark	Anti-diarrhoeal	-	Shukla et al., 2001
14.	Aqueous extract of seeds and flower	Antibacterial	-	Tambekar and Saratkar, 2005

CONCLUSION

The present overview describes taxonomy and biochemical constituents of *B. monosperma* along with its pharmacological activity against various diseases and disorder which have experimentally utilize in both animals and man. Further relevant studies required to study the mechanism by which *B. monosperma* displayed potential medicinal effects which needed to confirm by using clinical trails for its effective therapeutic activity.

This review provides an outlook on various aspects that need to be done to carry forward the available information in developing suitable clinical therapeutics.

ACKNOWLEDGEMENTS

Authors are grateful to the researchers working on medicinal plant *B. monosperma* without their research papers / review, preparation of this manuscript was not possible.

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Corresponding author: Dr. Amber Hasan, Department of Botany, Shia P.G. College, Lucknow, U.P., India
Email: ambar_hasan@gmail.com