

“Preliminary Phytochemical Screening and Thin Layer Chromatographic Profiling of *Butea monosperma* (Lam.) Kuntze Flower Extracts”

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Abstract

Medicinal plants are rich sources of bioactive compounds that contribute significantly to traditional and modern therapeutic systems. *Butea monosperma* (Lam.) Kuntze is a well-known medicinal plant extensively used in Indian ethnomedicine. The present investigation aimed to evaluate the phytochemical composition of flower extracts of *B. monosperma* using different solvents and to characterize major constituents through Thin Layer Chromatography (TLC). Dried flower powder was extracted successively using dichloromethane, chloroform, ethyl acetate, acetone, methanol, ethanol, and water. Qualitative phytochemical screening was performed using standard chemical tests, and TLC profiling was conducted using silica gel plates and toluene:ethyl acetate (9:1) as mobile phase. The results revealed the presence of triterpenoids, flavonoids, alkaloids, glycosides, tannins, sterols, and saponins in various extracts, with methanolic and ethanolic extracts exhibiting maximum phytochemical diversity. TLC analysis indicated the presence of multiple bioactive constituents with distinct R_f values. The findings scientifically validate the traditional use of *B. monosperma* flowers and provide baseline information for further phytochemical isolation and pharmacological studies.

Keywords: *Butea monosperma*, Phytochemical screening, Thin Layer Chromatography, Medicinal plants, Secondary metabolites

Introduction

Medicinal plants have been used since ancient times as primary sources of therapeutic agents and continue to play an important role in healthcare systems worldwide (Sofowora, 2008; WHO, 2013). Plant-derived secondary metabolites such as alkaloids, flavonoids, tannins, glycosides, terpenoids, and phenolic compounds are responsible for a wide range of pharmacological activities including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and anticancer properties (Harborne, 1998; Cowan, 1999; Trease and Evans, 2009). Phytochemicals are naturally synthesized compounds produced through primary and secondary metabolic pathways in plants and are distributed in various plant parts such as roots, stems, leaves, flowers, fruits, and seeds (Harborne, 1998). The qualitative and quantitative distribution of these compounds varies depending on species, plant part, environmental conditions, and extraction methods (Saxena et al., 2013; Pandey and Rizvi, 2009).

Butea monosperma (Lam.) Kuntze, belonging to the family Fabaceae, is commonly known as Palash or Flame of the Forest and is widely distributed in India and Southeast Asia (Das et al., 2011; Singh et al., 2017). The plant holds significant cultural and medicinal importance and is extensively mentioned in traditional Indian medicinal systems (Jhade et al., 2009; Gupta et al., 2017). Different parts of the plant are traditionally used in the treatment of dysentery, diabetes, inflammation, skin diseases, liver disorders, and urinary ailments (Sharma and Deshwal, 2011; Rana and Mazumdar, 2012). Previous studies have reported the presence of flavonoids, phenolics, sterols, glycosides, and terpenoids in various parts of *B. monosperma*, which contribute to its pharmacological activities (Das et al., 2011; Sharma and Deshwal, 2011; Firdaus and Mazumdar, 2012). Compounds such as butrin, isobutrin, and isocoreopsin have been identified and linked to antioxidant, hepatoprotective, and antidiabetic properties (Gupta et al., 2017; Singh et al., 2017).

Although several investigations have focused on the pharmacological and ethnomedicinal aspects of *B. monosperma*, systematic phytochemical profiling of flower extracts using multiple solvents and chromatographic techniques remains limited. Therefore, the present study was undertaken to qualitatively analyze the phytochemical constituents of *B. monosperma* flowers and to perform preliminary chromatographic characterization using TLC.

Materials and Methods

Plant Material Collection and Identification

Fresh flowers of *Butea monosperma* were collected during the flowering season (March–April) from the Kopargaon region, Maharashtra, India. The plant material was identified using standard floras and authenticated with reference to regional and national botanical literature

Preparation of Plant Material

The collected flowers were thoroughly washed with distilled water and shade-dried at room temperature. The dried petals were pulverized into coarse powder using a mechanical grinder and stored in airtight containers for further analysis

Extraction Procedure

Approximately 20 g of powdered flower material was successively extracted with 250 mL of dichloromethane, chloroform, ethyl acetate, acetone, methanol, ethanol, and distilled water using maceration and Soxhlet extraction techniques. Each extraction was carried out for about 4 hours until the solvent became colorless. The extracts were concentrated at 30–40°C and stored at 4°C for further analysis

Qualitative Phytochemical Screening

Qualitative phytochemical analysis was carried out using standard chemical tests as described by Harborne (1998) and Trease and Evans (2009). The following tests were performed:

- Triterpenoids: Liebermann–Burchard test
- Sterols: Liebermann–Burchard test
- Glycosides: Keller–Killiani test
- Flavonoids: Ferric chloride test
- Alkaloids: Wagner's test
- Proteins: Ninhydrin test
- Carbohydrates: Barfoed's test
- Saponins: Foam test
- Lipids: Soap formation test
- Tannins: Ferric chloride test

The presence or absence of phytochemicals was recorded as positive (+) or negative (–)

Thin Layer Chromatography

TLC analysis was performed on silica gel G plates activated at 110°C for 30 minutes. Ethanolic extracts (approximately 5 µL) were applied using capillary tubes. The mobile phase consisted of toluene:ethyl acetate (9:1, v/v) (Harborne, 1998; Wagner and Bladt, 2001). The developing chamber was pre-saturated for 20 minutes. After development, plates were air-dried and sprayed with vanillin–sulphuric acid reagent. Visualization was carried out under UV light at 254 and 366 nm. R_f values were calculated using standard formula.

Results

Phytochemical Screening

The qualitative phytochemical analysis revealed variation in phytochemical composition among different solvent extracts (Table 1). Triterpenoids were detected in all extracts. Flavonoids, alkaloids, glycosides, and tannins were predominantly present in methanolic, ethanolic, and chloroform extracts. Proteins were detected only in ethanolic extract, while carbohydrates were absent in all extracts. Saponins were mainly present in methanol and ethanol extracts, whereas lipids were detected in ethyl acetate extract

Methanolic and ethanolic extracts exhibited the maximum diversity of phytochemical constituents, indicating their higher extraction efficiency for polar compounds.

Table 1: Qualitative Phytochemical Screening of *Butea monosperma* in Different Solvents

Sr. No.	Phytochemical Test	Methanol	DCM	Ethyl Acetate	Ethanol	Chloroform	Acetone	Water
1	Triterpenoids	+	+	+	+	+	+	+
2	Sterols	+	–	+	+	+	+	–
3	Glycosides	–	–	+	+	+	+	–
4	Flavonoids	+	–	–	+	–	+	+
5	Alkaloids	+	–	+	+	+	+	–
6	Proteins	–	–	–	+	–	–	–
7	Carbohydrates	–	–	–	–	–	–	–
8	Saponins	+	–	–	+	+	–	–
9	Lipids	–	–	+	–	–	–	–
10	Tannins	+	+	–	+	+	+	+

Thin Layer Chromatography

TLC profiling revealed multiple distinct bands in different solvent extracts. Methanolic extract showed four prominent spots with Rf values (Table 2) ranging from 0.125 to 0.562. Ethyl acetate extract exhibited eight spots with Rf values ranging from 0.062 to 0.925, indicating high compound diversity. Chloroform and dichloromethane extracts also showed multiple bands with varying Rf values. The variation in Rf values suggests the presence of chemically diverse secondary metabolites in flower extracts.

Table 2-: Rf Values of Phytochemical Constituents of *Butea monosperma* in Different Solvent Systems by Thin Layer Chromatography (TLC)

Sr. No.	Solvent System	Spot No.	Distance by Solute (cm)	Distance by Solvent (cm)	Rf Value
1	Methanol	1	1.0	8.0	0.125
		2	1.6	8.0	0.200
		3	2.2	8.0	0.275
		4	4.5	8.0	0.563
2	Ethanol	1	1.0	8.0	0.125
		2	2.4	8.0	0.300
		3	4.5	8.0	0.563

Sr. No.	Solvent System	Spot No.	Distance by Solute (cm)	Distance by Solvent (cm)	Rf Value
3	Water	1	4.1	8.0	0.513
4	Dichloromethane	1	1.4	8.0	0.175
		2	2.4	8.0	0.300
		3	3.3	8.0	0.413
		4	3.9	8.0	0.488
		5	7.8	8.0	0.975
5	Ethyl Acetate	1	0.5	8.0	0.063
		2	1.0	8.0	0.125
		3	1.4	8.0	0.175
		4	1.9	8.0	0.238
		5	3.1	8.0	0.388
		6	4.6	8.0	0.575
		7	5.1	8.0	0.638
		8	7.4	8.0	0.925
6	Chloroform	1	1.4	8.0	0.175
		2	3.5	8.0	0.438
		3	4.5	8.0	0.563
		4	5.4	8.0	0.675
		5	7.7	8.0	0.963
7	Acetone	1	0.7	7.5	0.093
		2	1.1	7.5	0.146
		3	4.4	7.5	0.586
8	Dichloromethane Oil	1	0.3	7.5	0.040
		2	0.8	7.5	0.093

Discussion

The present study demonstrated the presence of several bioactive phytochemicals in *B. monosperma* flower extracts, supporting its traditional medicinal use. Flavonoids and phenolic compounds are known for their antioxidant and anti-inflammatory activities, while alkaloids possess antimicrobial and pharmacological properties (Cowan, 1999; Pandey and Rizvi, 2009). The predominance of phytochemicals in methanolic and ethanolic extracts may be attributed to the high polarity of these solvents, which enhances the extraction of phenolics, glycosides, and flavonoids (Sasidharan et al., 2011; Azwanida, 2015). Similar observations have been reported by Sharma and Deshwal (2011) and Das et al. (2011) in studies on *B. monosperma*. TLC profiling provided preliminary evidence of compound heterogeneity in flower extracts. Ethyl acetate and methanol extracts exhibited maximum band separation, indicating their

suitability for further chromatographic purification and compound isolation. Comparable chromatographic patterns have been reported in previous phytochemical studies on medicinal plants (Wagner and Bladt, 2001; Harborne, 1998). The present findings are consistent with earlier reports on the phytochemical composition of *B. monosperma* and further strengthen its potential as a source of pharmacologically active compounds.

Conclusion

The present investigation revealed that *Butea monosperma* flowers are rich in bioactive phytochemicals, particularly triterpenoids, flavonoids, alkaloids, glycosides, tannins, and sterols. Methanolic and ethanolic extracts showed maximum phytochemical diversity. TLC analysis confirmed the presence of multiple secondary metabolites. These findings scientifically validate the traditional medicinal applications of *B. monosperma* flowers and provide a foundation for future isolation, characterization, and pharmacological studies.

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