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# Formulation and Evaluation of Different Parts of Butea Monosperma

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## ABSTRACT

The medium-sized deciduous tree Butea monosperma (Lam.) kuntze [Family: leguminosae] is extensively found throughout India, Burma, and Ceylon and is also known as Flame of Forest, Dhak or palas in Hindi, Bastard Teak in English, and Parasa in Tamil. The Fabaceae family comprises 18,000 species and 630 genera. It grows from seed with ease. With each portion of the plant having a purpose, it is used both commercially and medicinally. In present context, in spite of various existing anti-inflammatory and antioxidant both in modern and ayurvedic field there is necessity of still better and cost effective which will reduce the dose and improve the efficacy, when it is combine administered without any adverse effects. The over usage of synthetic drug result in higher incidence of adverse reaction has motivated mankind to go back to nature for safe remedies. Thus, considering the above factors in present day, study has been taken to evaluate the Physico-chemical analysis and anti-inflammatory effect of Butea monosperma -An Experimental study.

***KEYWORDS:*** *Butea monosperma, anti-inflammatory, antioxidant, medicinal plant, Phytomedicines, Phytochemistry, Diclofenac, ethanolic*

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## INTRODUCTION

Earlier the foreword of contemporary medicines, disease treatment was completely managed by herbal medicines. It is estimated that about 70-80% of the earth inhabitants residing in the huge rural areas of the developing and under developed countries still depend mostly on medicinal plants [1]. Medicinal plants are the richest bio resource of drugs of conventional systems of medicine, contemporary medicines, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs [2]. Medicinal plants form a huge group of inexpensively significant plants that provide the essential raw materials for indigenous pharmaceuticals. Plant products still remain the most important source of pharmaceutical agents used in conventional medicine [4]. According to the WHO the primary step for recognition and purification of herbal drugs is the pharmacognostic (macroscopic and microscopic) studies which are necessary for any Phyto-pharmaceutical products used for standard formulation [5]. Preliminary phytochemical studies are obliging in finding out chemical constituents in the plant material that may fine lead to their quantitative estimation. The most significant of these bioactive constituents of plants are steroids, tannins, alkaloids, flavonoids and phenolic compounds. Therefore, it is enviable to know the phytochemical composition of the plant material before testing its effectiveness for medicinal purpose. Plants are also main natural sources of medicinal compounds in present pharmacopoeias. Indian Materia Medica comprises about 2000 drugs of natural origin and most of them are resulting from different conventional system and myths practices [6].

In traditional medicine, there are many natural crude drugs that have the potential to treat many disease and disorders one of them is Butea monosperma (Lam.) Taub (Syn. Butea frondosa; Family Fabaceae) popularly known as 'dhak' or 'palas', commonly known as 'Flame of forest', palash, mutthuga, bijasneha, khakara, chichara, Bastard teak, Bengal kino. They comprise one of the largest families of flowering plants, numbering 630 genera and 18,000 species[7]. This is a moderate sized deciduous tree which is widely distributed throughout India, Burma and Ceylon extending in the north west himalayas as far as jhelum except in very acrid parts. B. monosperma, is a moderate sized deciduous tree. The genus Butea refers to beautiful appearance of flowers. The specific name monosperma means 'one seeded and refers to the fruit with a single seed near its apex' is commonly known as Flame of forest, belonging to the family Fabaceae [8]. The genus Butea includes B. monosperma parviflora, Butea minor and Butea superba widely distributed throughout India. It is elucidated in Upanishads, Vedas, Susrirta Samhita, Charaka Samhita, Astanga Sangraha, Ashtanga Hrdaya.

B. monosperma can be found in South Asia and the Indian Subcontinent's tropical and subtropical regions. It can be found in India, Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar, Thailand, Malaysia, Laos, Cambodia, Vietnam. It is also found in Western Indonesia [9].

**Fig 1. Butea monosperma**

**Phytomedicines and Phytochemistry:**

Phytochemicals (from greek word phyto, meaning plant) are biologically active, naturally occurring chemical compounds found in plants, which provide health benefits for humans. They protect plants from disease and damage and contribute to the plant's colour, aroma and flavor. In general, the plant chemicals that protect plants cells from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attack are called as phytochemicals [10].

The dietary phytochemicals are found in fruits, vegetables, legumens, whole grains, nuts, seeds, fungi, herbs and spices. Broccoli, cabbage, carrots, onions, garlic, whole wheat bread, tomatoes, grapes, strawberries, beans and soy foods are common sources. Phytochemicals accumulate in different parts of the classified by protective function, physical and chemical characteristis. Many phytochemicals particularly the pigment molecules, are often concentrated in the outer layers of the various plant tissues. Levels vary from plant to plant depending upon the variety, processing, cooking and growing conditions. These compounds are known as secondary plant metabolites and have biological properties such as antioxidant activity, antimicrobial effect, modulation of detoxification enzymes, stimulation of the immune system, decrease of platelet aggregation and modulation of hormone metabolism and anticancer property. There are more than thousand known and many unknown phytochemicals. It is well-known that plants produce these chemicals to protect human against diseases [11].

Studies carried out during the past 2-3 decades have shown that these phytochemicals have important role in preventing chronic diseases like cancer, diabetes and coronary heart disease . There is, however, much scope for further systematic research in screening Indian medicinal plants for these phytochemicals and assessing their potential in protecting against different types of diseases.

**Medicinal Uses**

*Butea monosperma* is a cynosure of contemporary medicine and is utilised in Ayurveda, Unani and homoeopathic treatments. This genus' plants are well recognised for their pigmentation and they are planted as an ornamental because of its sulphur-coloured flower. It is commonly used in as tonic, astringent, aphrodisiac and diuretics. Their seeds act as an inflammation and it is helpful in the treatment of tumours, intestinal worms, bleeding piles, urinary stones, skin and eye conditions, and gastrointestinal problems. Rubefacient properties are exhibited by seeds when mashed with lemon juice and applied on the skin. Flowers are use in the treatment of liver disorders. In India farmers use this plant to stabalize the field bunds. Root shows analgesic, aphrodisiac and antifertility activities which are useful in filariasis, piles, night blindness, ulcer, helminthiasis and tumours. Bark fibre is employed in the production of paper, cordage, and caulk for boat seams. Although leaves are high in nutrients and can be utilised as a moderate fuel, their limited digestibility makes them just slightly more digestible

than straws. The wood is burned to make gunpowder [12].

**Rational behind using plant *Butea monosperma* for anti-inflammatory activities:**

Hydroethanolic extracts of B. monosperma flowers reduce pro-inflammatory cytokines (IL-8, IL-1β, IL-6) in human keratinocytes, mitigating skin inflammation. Methanolic flower extracts (600–800 mg/kg) also suppress edema and granuloma formation in carrageenan-induced rat models.

Flavonoids like butein and butrin inhibit cyclooxygenase (COX) and lipoxygenase (LOX) enzymes, which are central to prostaglandin and leukotriene synthesis. This mechanism parallels NSAIDs but with fewer side effects.

Polyphenols (e.g., butrin, isobutrin) scavenge free radicals, reducing oxidative stress that exacerbates chronic inflammation. Ethyl acetate and chloroform extracts stabilize cell membranes and lower lipid peroxidation.

Traditionally used for arthritis, gout, and respiratory inflammation, its efficacy is now supported by preclinical studies showing reduced TNF-α, IL-6, and NF activity [13].

**Objectives**

- To overview of Butea monosperma
- To study phytomedicines and phytochemistry
- To study medicinal uses of Butea monosperma
- To study butea monosperma for anti-inflammatory activities
- To study macroscopy study of Butea monosperma Species
- To study phytochemical analysis of ethanolic extract of Butea monosperma
- To study antiinflammatory activity of Butea monosperma

**Review of Literature**

Kaur et al., (2020) Evaluated the anti-oxidative and DNA-protective abilities of the Bchl and Beac fractions obtained from the bark of B. monosperma, along with their anti-proliferative activity against the MCF-7 breast cancer cells via the apoptotic pathway. Apoptosis induction in MCF-7 cells caused by both Bchl and Beac fractions was observed to be associated with DNA damage, ROS generation, and the loss of MMP. These findings established a strong base to conduct further research on the herbal drug formulations obtained from the bark of B. monosperma, which could possibly be used against breast cancer [14].

Tiwari et al., (2019) Evaluated the anti-oxidant activity of ethanol, petroleum ether, ethyl acetate, chloroform and hexane was estimated from B. monosperma leaves extracts show antioxidant effects [15].

Pawar et al., (2019) Evaluated that a triterpene whose name is TBM has been found in palash. TBM shows anticonvulsant activity against seizure induced by MES (Maximum Electro Shock), lithium sulphate, and pilocarpine nitrate, electrical killing, and pentylenetetrazol (PTZ). It also shows depressant effect on CNS after continuous use of 7 days [16].

Munawar et al., (2018) Evaluated antibacterial and antioxidant activity of ethanolic extracts of flowers and stem of Butea monosperma. Antibacterial activity of ethanolic extracts was also evaluated and MIC values were calculated by broth dilution method. Extracts prevented the growth of gram-positive bacteria such as Staphylococcus aureus and Bacillus subtilis and gram-negative bacteria such as E. coli and Pseudomonas aeruginosa, the MIC values of ethanolic extract of the flower were higher than those of the stem extract. Antioxidant activity was assayed by the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity, nitroblue tetrazolium (NBT) and ferric reducing power (FRAP). In all the assays, stem extract exhibited stronger antioxidant activity than that of flower [17].

Kushwaha et al., (2017) Concluded that biological interactions are a central aspect of the biological diversity. The overall goal of the study associated with Palash tree is to enhance biodiversity and the abundance of avian species. Such regions are often particularly intended to enhance the abundance of pollinators such as bees, butterflies and birds, through the provision of food resources, for example nectar-rich flowers of Palash. Such pollinators and pest predators are important in the context of agricultural production. Birds can also benefit from high insect numbers attracted to Butea monosperma as they are good food resource for birds. The plantation and management of Butea monosperma will be beneficial for the birds, invertebrates and the local farmers [18].

Gupta et al., (2015) Evaluated Ethanolic extract of Butea monosperma (Lam.) Taub bark was evaluated for in-vivo antioxidant activity. Trunk bark consists ;of two distinct regions i.e. outer bark and inner bark. Outer bark consists of broad periderm of a wide phellem and inner phelloderm regions. Inner bark is broader than the outer part and it includes all the secondary phloem tissues. It can be concluded that the pharmacognostic profile of the Butea monosperma (Lam.) Taub is helpful in developing standards for quality, purity and sample sidentification. The free radical scavenging activity of ethanolic bark extract of Butea monosperma (Lam.)

Taub showed good activity as compared to standard [19].

Kumar et al., (2014) Purposed study of anti-inflammatroy, analgesia and antipyretic activities of methanolic extract of Gynocardia odorata roxb (MEGO) in rats and mice. Anti-inflammatory activity includes carrageenan induced paw edema in rats. MEGO reduced paw edema after five hours of carrageenan injection. The extract as well as paracetamol induced antinociceptive effect. The higher antinociceptive effects of extract due to presence of flavonoids and phenolic compounds [20].

Gupta et al., (2012) Evaluated the anti-diabetic activity of ethanolic extract of B. monosperma leaves (BMEE) on alloxan induced diabetes model in male rats the leaves have hypoglycemic effects by the fact that BMEE lowers fasting blood glucose levels and boosts the action of antioxidant enzymes during treatment at a dose of 300 mg/kg for 45 days [21].

Govindappa et al., (2011) Evaluated the different solvent extracts of C. pallida possess antimicrobial, antioxidant and anti-inflammatory properties. These activities may be due to the strong occurrence of polyphenolic compounds, such as flavonoids, tannins, terpenoids, phenols, and saponins. The extracts fractions showed strong antimicrobial activity. The extract fractions serve as free radical inhibitors or scavengers, or they act possibly as primary oxidants. They inhibit the heat induced albumin denaturation and proteinase activity and stabilize the Red Blood Cells membrane. ethanol, ethyl acetate and petroleum ether extracts attributed potent inhibition of bacteria and fungi and they yielded strong presence of phytochemicals. These extracts also exhibited antioxidant and anti-inflammatory properties strongly [22].

Sharma et al., (2011) Evaluated the antihyperglycemic, antihyperlipidemic and antioxidative properties of hydroethanolic extract of butea monosperma bark was investigated in alloxan induced diabetic mice. Alloxan administration resulted in higher blood glucose level and reduced hepatic glycogen content as compared to normal animals. The level of high-density lipoprotein cholesterol was markedly reduced in diabetic animals. Antihyperglycemic and antioxidant potential of the crude extract of B. monosperma bark indicated that it may find use in the management of diabetes and resultant oxidative stress [23]

**Research Methodology**

A research methodology is a universal way to addressing a study subject through data collection, data evaluation, and results based on the findings of the study. A research technique is a plan for carrying out a research study.The methodical gathering and analysis of facts and information for the advancement of knowledge in any area may be loosely defined as research. The goal of the study is to use systematic techniques to find solutions to intellectual and practical problems. "Scholarly inquiry or investigation; specifically, inquiry or experimentation directed at the exploration and clarification of data, modification of existing techniques or laws in light of new facts, or practical application of such new or updated theories or laws," according to Webster's Collegiate Dictionary. Some individuals think of research as a journey from the known to the unknown

**Result and Discussion**

The macroscopy of stem bark of *Butea monosperma* species were observed using simple microscope or naked eye.

**Table 1 Macroscopy study of *Butea monosperma* Species.**

| Sr. No. | Features | Leaf | Stem bark | Flower |
|---|---|---|---|---|
| 1. | Color | Dark green or light green | Greyish brown to dark brown | Bright orange to red |
| 2. | Odor | None | Characteristic | Slightly characteristic |
| 3. | Surface | Smooth with fine hairs | Rough and cracks | Smooth |
| 4. | Texture | Leathery | Hard, fibrous | Soft and fleshy |
| 5. | Taste | Astringent and Slightly Bitter | Bitter | Astringent and slightly sweet |

The ethanolic extract of different part of *Butea monosperma* were subjected to qualitative phytochemical tests to identify the phytoconstituents and it is found that the different part of *Butea monosperma* species possess positive result for alkaloids, carbohydrates, glycosides, saponins, terpenoids, tannins, phenols, flavonoids.[24]

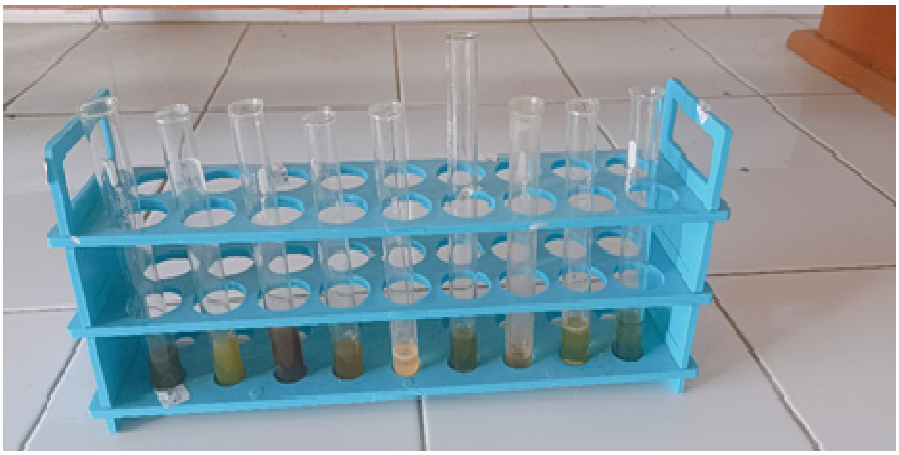


**Fig 2. Phytochemical screening of *Butea monosperma* extract**

**Table 2. Phytochemical analysis of ethanolic extract of *Butea monosperma*.**

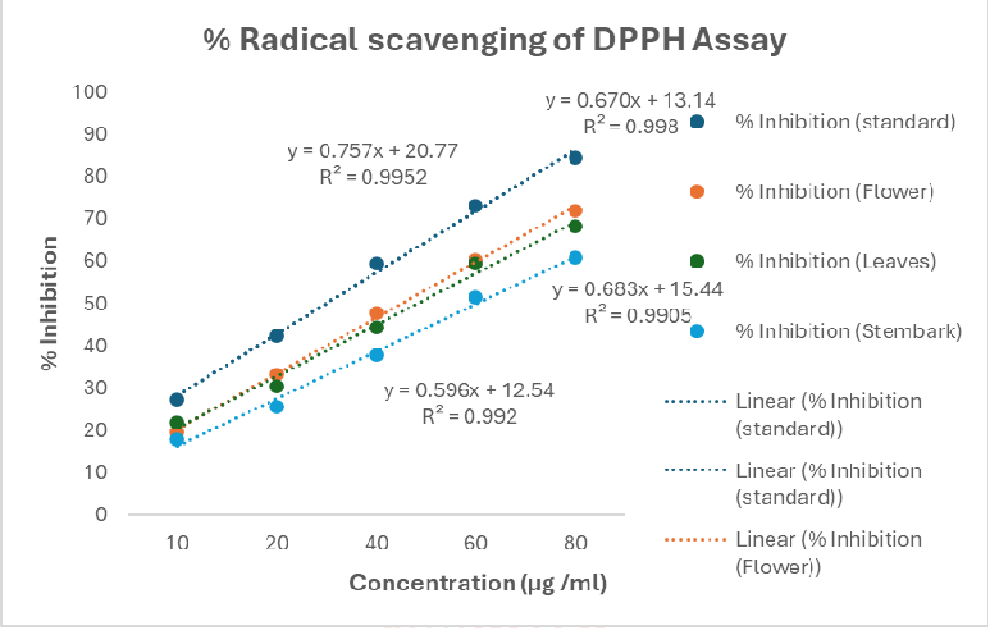
| Sr. no. | Phytochemical constituents | Leaf extract | Stem bark Extract | Flower extract |
|---|---|---|---|---|
| **1.** | **Alkaloids** | **Observation or Inference** | | |
| **a.** | Dragondorff' test | Positive, red ppt | Positive, orange ppt | Negative |
| **b.** | Mayer's test | Positive, white ppt | Positive | Positive, cream ppt |
| **c.** | Hager's test | Negative | Positive, yellow colour | Positive |
| **d.** | Wagner's test | Yellow ppt | Yellow ppt | Negative |
| **2.** | **Carbohydrates** | **Observation or Inference** | | |
| **a.** | Molisch's test | Positive, violet ring formation | Positive, violet ring formation | Positive, violet ring formation |
| **b.** | Fehling's test | Red ppt | Red ppt | Negative |
| **c.** | Benedict's test | Orange red ppt | Orange red ppt | Negative |
| **3.** | **Glycosides** | **Observation or Inference** | | |
| **a.** | Borntrager's test | Negative | Positive, pink color in ammonical layer | Negative |
| **b.** | Legal test | Negative | Negative | Negative |
| **4.** | **Saponins** | **Observation or Inference** | | |
| **a.** | Froth test/ Foam test | Positive, Persistent foam/froth; foam layer ≥1 cm | Positive, Persistent foam/froth; foam layer ≥1 cm | Positive, Persistent foam/froth; foam layer ≥1 cm |
| **5.** | **Terpenoids** | **Observation or Inference** | | |
| **a.** | Salkowski's Test | Positive, Reddish-brown colour | Positive, Reddish-brown colour | Positive, Reddish-brown colour |
| **6.** | **Phenols** | **Observation or Inference** | | |
| **a.** | $FeCl_3$ Test | Positive, Blackish or greenish coloration/precipitate | Positive, Blackish or greenish coloration/precipitate | Positive, Blackish or greenish coloration/precipitate |
| **7.** | **Tannins** | **Observation or Inference** | | |
| **a.** | Gelatin test | Positive, White precipitate forms | Negative, No white precipitate | Negative, No white precipitate |
| **8.** | **Flavonoids** | **Observation or Inference** | | |
| **a.** | Alkaline reagent Test | Negative, No yellow colour | Positive, Yellow coloration appears | Positive, Yellow coloration appears |
| **b.** | Lead acetate Test | Negative, No yellow ppt | Positive, Yellow precipitate forms | Positive, Yellow precipitate forms |
| **9.** | **Proteins** | **Observation or Inference** | | |
| **a.** | Xanthoproteic Test | Negative | Negative | Negative |
| **10.** | **Amino acid** | **Observation or Inference** | | |
| **a.** | Ninhydrin Test | Negative | Negative | Negative |

The DPPH radical scavenging activity of the extracts was recorded in terms of percent inhibition, with *Butea monosperma* flower extract exhibiting an inhibition of 51.1 %) and *Butea monosperma* leaves extract (50.6%). In terms of the amount of flavonoid and phenol contents and their anti-oxidant activities. Hence, these three extracts were studied for their reducing power and anti-inflammatory activity. [25]

**Table 3. % Inhibition of different concentration by standard drug and extract of *Butea monosperma* different parts.**

| Sr. no. | Concentration (µg /ml) | % Inhibition (standard) | % Inhibition (Flower) | % Inhibition (Leaves) | % Inhibition (Stembark) |
|---|---|---|---|---|---|
| **1.** | 10 | 27.34 | 19.48 | 21.94 | 17.86 |
| **2.** | 20 | 42.34 | 33.26 | 30.41 | 25.51 |
| **3.** | 40 | 59.38 | 47.75 | 44.39 | 37.76 |
| **4.** | 60 | 72.95 | 60.30 | 59.39 | 51.53 |
| **5.** | 80 | 84.48 | 71.83 | 68.16 | 60.71 |
| | **IC50** | **38.5** | **51.1** | **50.6** | **62.8** |

**Fig 3. Linear Graph indicating % Inhibition of different concentration by standard drug and ethanolic extract of *Butea monosperma* different parts.**

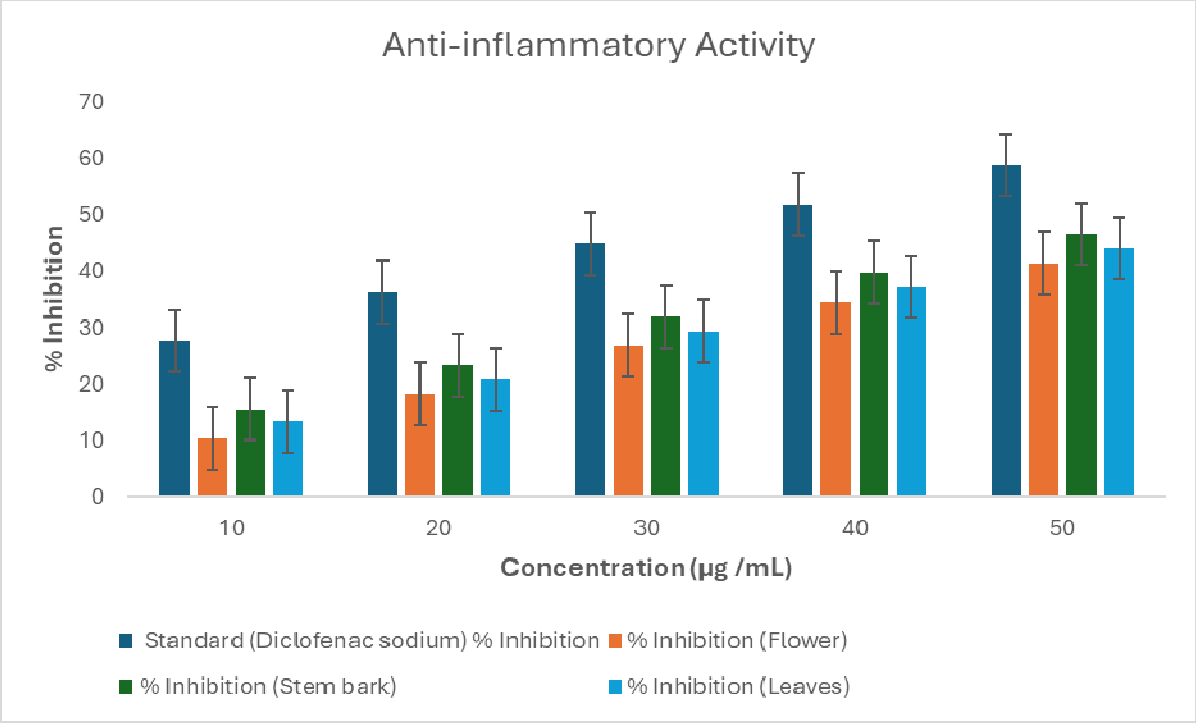



The anti-inflammatory assay employs the principle of albumin denaturation at high temperatures. Here, the drug diclofenac was used as the standard. The results are shown in Graph. *Butea monosperma* stem bark extract worked better at inhibiting albumin denaturation, compared to the leaves and flower. [26]

**Table 4: % Inhibition of different Concentrations of Standard drug Diclofenac and extract of *Butea monosperma* different parts.**

| Sr. no. | Concentration (µg /ml) | Standard (Diclofenac sodium) % Inhibition | % Inhibition (Flower) | % Inhibition (Stem bark) | % Inhibition (Leaves) |
|---|---|---|---|---|---|
| **1.** | 10 | 27.59 | 10.34 | 15.52 | 13.35 |
| **2.** | 20 | 36.21 | 18.10 | 23.28 | 20.69 |
| **3.** | 30 | 44.83 | 26.73 | 31.90 | 29.31 |
| **4.** | 40 | 51.72 | 34.48 | 39.66 | 37.07 |
| **5.** | 50 | 58.62 | 41.38 | 46.55 | 43.97 |
| | **IC50** | **38** | **60.3** | **53.7** | **57.2** |

**Fig 4. Bar Graph indicating % Inhibition of different concentration by standard drug and ethanolic extract of *Butea monosperma* different parts.**




## Conclusion

The comprehensive study of different parts of Butea monosperma reveals significant variations in their morphological, physicochemical, phytochemical, and biological properties. Macroscopically, the leaves, stem bark, and flowers exhibit distinct colors, textures, and tastes, which aid in their identification and quality assessment. Microscopic examination further confirms characteristic anatomical features such as concentric tissue arrangements in the stem bark and specialized structures in the leaves and flowers, supporting their botanical authenticity. Physicochemical analyses indicate that the stem bark contains higher moisture and mineral content, while the leaves yield the highest extractive value, suggesting a richer presence of soluble phytoconstituents. Phytochemical screening demonstrates the presence of diverse bioactive compounds including alkaloids, saponins, terpenoids, phenols, tannins, and flavonoids, with some variation among plant parts. Fluorescence and foaming index analyses provide additional tools for authentication and indicate substantial saponin content across all parts

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