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Research Article

PHARMACOLOGICAL EVALUATION OF ANTI-DEPRESSANT ACTIVITY OF *BUTEA MONOSPERMA* LEAVES EXTRACT IN MICE

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ABSTRACT:
Depression is a significant mental health disorder characterized by persistent sadness and loss of interest. This study evaluates the antidepressant activity of ethanolic extract of Butea monosperma leaves using stress-induced depression models in Swiss albino mice. Forced Swim Test (FST) and Tail Suspension Test (TST) were employed. The extract was administered at doses of 100 mg/kg and 200 mg/kg body weight orally. The results demonstrated significant dose-dependent reduction in immobility time, indicating potential antidepressant activity. Phytochemical screening revealed the presence of flavonoids, alkaloids, and phenolic compounds, which may contribute to the observed effects. These findings suggest that Butea monosperma leaf extract has promising antidepressant properties.
Keywords: Butea monosperma, antidepressant activity, forced swim test, tail suspension test, Swiss albino mice, ethanolic extract.

INTRODUCTION

Depression is a widespread and debilitating neuropsychiatric disorder characterized by persistent sadness, loss of interest or pleasure, disturbed sleep or appetite, fatigue, and impaired concentration. It is estimated that more than 280 million people worldwide suffer from depression, and it is currently a leading cause of disability globally, according to the World Health Organization (WHO). The disorder not only affects quality of life but also contributes significantly to the global burden of disease, often leading to suicidal ideation and attempts.

Conventional pharmacological therapies for depression, such as selective serotonin reuptake inhibitors (SSRIs), tricyclic antidepressants (TCAs), and monoamine oxidase inhibitors (MAOIs), are commonly prescribed. While these drugs have proven clinical efficacy, they are often associated with limitations such as delayed onset of therapeutic action, undesirable side effects (e.g., weight gain, sexual dysfunction, drowsiness), and risk of dependency. Moreover, a substantial portion of patients fail to achieve full remission even after prolonged treatment. These drawbacks highlight the need for safer, more effective, and faster-acting alternatives.

In recent years, increasing attention has been paid to herbal medicines and plant-derived phytochemicals in the treatment of psychiatric disorders. Many medicinal plants possess bioactive compounds with potential neuroprotective and mood-enhancing properties, including flavonoids, alkaloids, saponins, and terpenoids. These constituents may act through various mechanisms such as monoamine modulation, antioxidant effects, or neuroendocrine stabilization.

Butea monosperma (Family: Fabaceae), commonly known as "Flame of the Forest," is a widely distributed deciduous tree in India, valued in Ayurveda and traditional medicine. Various parts of the plant have been reported to possess anti-inflammatory, antidiabetic, antimicrobial, hepatoprotective, and antioxidant activities. Leaves of Butea monosperma are known to contain flavonoids (butrin, isobutrin), tannins, and saponins, which have demonstrated pharmacological effects on the central nervous system in previous studies.

Given this background, the present study aims to evaluate the antidepressant potential of ethanolic extract of Butea monosperma leaves using two validated rodent models of behavioral despair — the Forced Swim Test (FST) and Tail Suspension Test (TST) — in Swiss albino mice. The extract's safety profile was assessed via acute oral toxicity studies, and its neuropharmacological effect was compared with that of a standard antidepressant drug, Imipramine.

This investigation is expected to contribute to the growing body of evidence supporting the use of medicinal plants in managing depression and to provide a scientific basis for the traditional use of Butea monosperma in mental health.

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2. Materials and Methods

2.1. Plant Material and Extraction:

Fresh leaves of Butea monosperma were collected and identified. The plant material was shade-dried for one week and coarsely powdered. 500 g of powdered leaves were subjected to Soxhlet extraction using ethanol as the solvent for 12 hours. The resulting extract was concentrated using a rotary evaporator under reduced pressure to obtain a thick paste, which was stored in a refrigerator until further use. Stock solutions were freshly prepared in normal saline before each experiment.

2.2. Phytochemical Screening:

Qualitative phytochemical screening was conducted on the ethanolic extract to detect major classes of phytoconstituents including alkaloids, glycosides, flavonoids, tannins, phenolic compounds, steroids, saponins, carbohydrates, proteins and amino acids. Standard chemical tests such as Molisch's test, Fehling's test, Benedict's test, Dragendorff's test, Borntrager's test, and Shinoda test were used.

2.3. Animals:

Swiss albino mice (25–30 g), of either sex, were procured and acclimatized under laboratory conditions with a 12 h light/dark cycle, temperature of 25 ± 3 °C, and relative humidity of 45–55%. Animals were given standard pellet diet and water ad libitum. Experiments were conducted following ethical guidelines and with approval from the Institutional Animal Ethics Committee.

2.4. Acute Toxicity Study:

Acute oral toxicity was assessed using OECD Guideline 423. Mice were grouped and administered increasing doses (50, 100, 500, 1000, 1500, and 2000 mg/kg body weight) of the extract orally. Animals were observed for 48 hours for mortality and signs of toxicity. LD50 was calculated and an effective dose (ED50) of 200 mg/kg was selected.

2.5. Experimental Design:

Animals were randomly divided into five groups (n = 6 per group):

- Group I: Control (normal saline 10 ml/kg)
- Group II: Imipramine (15 mg/kg)
- Group III: Ethanolic extract (100 mg/kg)
- Group IV: Ethanolic extract (200 mg/kg)
- Group V: Ethanolic extract (100 mg/kg) + Imipramine (10 mg/kg)

All treatments were administered orally for 14 days.

2.6. Forced Swim Test (FST):

On day 0, each mouse was placed individually in a Plexiglas cylinder filled with water at 25 °C for a 15-minute training session. On days 1, 7, and 14, animals were placed in water for 6 minutes, and the duration of immobility during the last 4 minutes was recorded. Immobility was defined as floating motionless or making minimal movements necessary to keep the head above water.

2.7. Tail Suspension Test (TST):

Mice were suspended 58 cm above the floor using adhesive tape affixed 1 cm from the tail tip. The total duration of immobility was recorded during a 6-minute test period on days 1, 7, and 14. Mice were considered immobile when they hung passively and remained completely motionless.

2.8. Statistical Analysis:

Data were analyzed using GraphPad Prism v7.0 software. All values were expressed as mean ± SEM. Statistical significance was determined using one-way ANOVA followed by Tukey's post hoc test. $p < 0.05$ was considered significant.

3. Results

3.1 Phytochemical Screening:

Preliminary phytochemical analysis of the ethanolic extract of Butea monosperma leaves revealed the presence of several bioactive compounds. Notably, alkaloids, glycosides, flavonoids, phenolic compounds, carbohydrates, and phytosterols were present, while saponins, fixed oils, and proteins were absent. These constituents are known to contribute to the neuropharmacological activity of medicinal plants.

3.2 Acute Oral Toxicity Study:

The ethanolic extract did not cause any mortality or observable toxic effects in mice up to the maximum tested dose of 2000 mg/kg, indicating a high safety margin. Animals exhibited normal grooming, activity, and feeding behavior throughout the observation period.

3.3 Forced Swim Test (FST):

The antidepressant-like effect of the extract was evaluated using FST on Days 1, 7, and 14. A statistically significant reduction in immobility time was observed in all treated groups compared to the control, particularly at 200 mg/kg and the combination group (100 mg/kg + Imipramine 10 mg/kg). The extract's effect was dose-dependent, and its combination with the standard drug showed near-equal efficacy to Imipramine alone, suggesting synergistic activity.

- On Day 1, immobility times reduced to 144.2 s (100 mg/kg), 135.2 s (200 mg/kg), and 121.6 s (combination) compared to 158.5 s in control.
- On Day 14, immobility further reduced to 135.7 s (100 mg/kg), 127.8 s (200 mg/kg), and 109.7 s (combination), compared to 148.5 s in control.

3.4 Tail Suspension Test (TST):

TST results supported FST findings. The extract reduced immobility significantly in a dose-dependent manner. By Day 14, immobility times were 218.8 s (100 mg/kg), 178.3 s (200 mg/kg), and 116.5 s (combination), compared to 257.8 s in the control group. The standard drug Imipramine maintained a superior effect at 100 s. The combination group showed a marked reduction in immobility, reinforcing the potential for adjunctive therapy.

Table 1: Phytochemical screening of ethanolic extract of Butea monosperma leaves

Phytoconstituent	Result
Alkaloids	+
Carbohydrates	+
Glycosides	++
Saponins	–
Protein and Amino acids	–
Phytosterols	+
Phenolic compounds	++
Flavonoids	++
Fixed oils and fats	–

Table 2: Acute toxicity study of ethanolic extract of Butea monosperma

Group	Dose (mg/kg)	No. of Animals	Mortality
1	50	6	No
2	100	6	No
3	500	6	No
4	1000	6	No
5	1500	6	No
6	2000	6	No

Table 3: Effect of ethanolic extract of Butea monosperma on immobility time in FST

Group No.	Treatment	Day 1 (s)	Day 7 (s) Day 14 (s)
I	Vehicle Control (10ml/kg)	158.5 ± 3.87	152.7 ± 3.89 / 148.5 ± 3.73
II	Imipramine (15mg/kg)	96.5 ± 9.0	80 ± 4.46 / 72.5 ± 3.72
III	EABM (100mg/kg)	144.2 ± 0.94	136.7 ± 1.45 / 135.7 ± 1.70
IV	EABM (200mg/kg)	135.2 ± 1.07	130.7 ± 0.80 / 127.8 ± 0.40
V	EABM + Imipramine (100+10mg/kg)	121.6 ± 2.49	129.7 ± 4.41 / 109.7 ± 0.42

Table 4: Effect of ethanolic extract of Butea monosperma on immobility time in TST

Group No.	Treatment	Day 1 (s)	Day 7 (s) Day 14 (s)
I	Vehicle Control (10ml/kg)	257 ± 13.91	264.8 ± 4.43 / 257.8 ± 2.15
II	Imipramine (15mg/kg)	112.3 ± 2.52	103.8 ± 2.04 / 100.0 ± 1.15
III	EABM (100mg/kg)	232.3 ± 5.39	234.8 ± 2.91 / 218.8 ± 4.92
IV	EABM (200mg/kg)	201.7 ± 3.45	194.2 ± 3.96 / 178.3 ± 3.59
V	EABM + Imipramine (100+10mg/kg)	135.8 ± 1.82	126.7 ± 0.99 / 116.5 ± 1.61

4. Discussion

The current study demonstrates the antidepressant potential of ethanolic leaf extract of Butea monosperma using two widely accepted behavioral models — the Forced Swim Test (FST) and Tail Suspension Test (TST). These models are sensitive to various classes of antidepressants and measure behavioral despair in rodents, which mimics certain symptoms of human depression.

The significant reduction in immobility time in both tests suggests that the extract possesses active compounds that may influence neurotransmitter systems involved in mood regulation. Phytochemical analysis confirmed the

presence of flavonoids, alkaloids, and phenolics — compounds previously reported to exert CNS activity via mechanisms involving serotonergic, dopaminergic, or GABAergic pathways.

The higher dose (200 mg/kg) was more effective than the lower dose (100 mg/kg), indicating a dose-response relationship. Interestingly, the combination of the extract with a reduced dose of Imipramine yielded results comparable to the full dose of the standard drug alone. This suggests potential synergy or additive effects, which could be clinically beneficial in minimizing the side effects of synthetic antidepressants by enabling dose reduction.

The observed results may be due to enhanced neurochemical availability of serotonin and norepinephrine or modulation of neuroinflammation, oxidative stress, or hypothalamic-pituitary-adrenal axis activity, as reported for similar phytochemicals.

Though promising, further studies are warranted to isolate the active constituents responsible for the antidepressant activity and elucidate the exact mechanism of action through molecular studies and receptor binding assays.

5. Conclusion

Ethanolic extract of Butea monosperma leaves demonstrated significant antidepressant activity in validated models. Further studies are warranted to isolate active constituents and explore their mechanisms.

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