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Evaluation of Anti-Depressant Behaviour of Alcoholic Extract of *Tectona grandis* Linn. on Rats

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Abstract:

Depression is a prevalent and debilitating mental disorder affecting millions of individuals worldwide. While pharmaceutical drugs have been the primary treatment for depression, there is a growing interest in exploring natural remedies, including plant-based extracts. Tectona grandis Linn., commonly known as teak, is a tropical tree with a history of traditional medicinal use. This study aimed to investigate the potential antidepressant effects of the alcoholic extract of Tectona grandis Linn. on a rat model. In this experimental study, adult male Wistar rats were subjected to behavioral tests to induce depressive-like behavior, including the forced swim test (FST) and tail suspension test (TST). The rats were then administered varying doses of the alcoholic extract of Tectona grandis Linn. orally for a specified period. The animals were subsequently re-evaluated using the same behavioral tests. The results were compared to a control group treated with a placebo. The findings of this study demonstrated that the alcoholic extract of Tectona grandis Linn. exhibited significant antidepressant-like effects in the rat model. Rats treated with the extract displayed reduced immobility time in both the FST and TST, indicative of improved mood and decreased depressive-like behaviour compared to the control group. The dose-dependent response suggested that higher doses of the extract were associated with more pronounced antidepressant effects. This research provides preliminary evidence supporting the potential antidepressant properties of the alcoholic extract of Tectona grandis Linn. on a rat model. Further studies are warranted to elucidate the underlying mechanisms of action and to evaluate its safety and efficacy in humans. If confirmed, Tectona grandis Linn. may hold promise as a natural remedy for depression, offering an alternative or complementary approach to conventional antidepressant medications.

Keywords: Depression, Force Swimming Test, Tail Suspension Test, Immobility

1. Introduction

Depression, often referred to as a "silent epidemic," is a pervasive and debilitating mental health disorder that affects millions of individuals worldwide [1]. It is characterized by persistent feelings of sadness, hopelessness, and a pervasive lack of interest or pleasure in daily activities. Depression not only imposes immense suffering on those affected but also poses a substantial societal and economic burden [2]. According to the World Health Organization (WHO), depression is the leading cause of disability globally, with an estimated 264 million people affected as of 2020. Furthermore, its prevalence continues to rise, particularly in the wake of the global COVID-19 pandemic, which has added to the complexities of mental health management [3]. Despite the high prevalence and severity of depression, the available treatments, including psychotherapy and pharmacotherapy, do not always yield satisfactory results for all individuals. Antidepressant medications, while effective for many, are associated with side effects, a delayed onset of action, and concerns about long-term use. Moreover, a significant portion of the population remains resistant to currently available antidepressants, highlighting the pressing need for novel and more effective therapeutic options.

In recent years, there has been a growing interest in exploring natural remedies and complementary therapies for the management of depression. Plant-based remedies, in particular, have gained attention due to their long history of traditional use, perceived safety, and the potential to offer new avenues for treatment [4]. One such natural resource under investigation is Tectona grandis Linn., commonly known as teak. Tectona grandis Linn. is a tropical hardwood tree native to South Asia, including countries such as India, Indonesia, Myanmar, and Thailand. Revered for its durable and versatile wood, teak is extensively used in the construction of furniture, boats, and outdoor structures. Beyond its significance in the timber industry, various parts of the Tectona grandis plant have been explored for their medicinal properties in traditional and folk medicine systems. The use of teak and its extracts in traditional medicine systems dates back centuries, and it has been traditionally employed to address various health conditions. While its therapeutic applications encompass a wide range of ailments, including digestive disorders and skin conditions, the focus of this research paper lies in its potential role as an antidepressant agent [5]

The exploration of plant extracts as potential treatments for mental health disorders, including depression, is grounded in the age-old practice of using natural substances to alleviate suffering. Many plant species, known as phytomedicines or herbal remedies, have exhibited promising results in preclinical and clinical studies targeting depression [6,7].

Tectona grandis has a well-documented history of traditional medicinal use in several regions. Indigenous communities have harnessed the plant's properties for various health-related purposes, and this traditional knowledge forms a strong foundation for scientific investigation. Preliminary research has suggested that Tectona grandis may possess pharmacological properties that could be relevant to the treatment of depression. These properties include antioxidant, anti-inflammatory, and neuroprotective effects, all of which have potential relevance in addressing the complex neurobiology of depression. Tectona grandis is rich in diverse phytochemical compounds, including terpenoids, flavonoids, and polyphenols, which have been linked to various biological activities. These compounds offer a broad spectrum of potential mechanisms through which Tectona grandis could exert antidepressant effects. While teak has been extensively studied for its wood and timber-related applications, its potential as a therapeutic agent for mental health remains relatively understudied. This knowledge gap underscores the need for rigorous scientific investigation to unlock its medicinal potential fully [8,9,10].

The primary objective of this research paper is to rigorously evaluate the antidepressant behavior of the alcoholic extract of Tectona grandis Linn. using a rat model. This study seeks to elucidate whether the plant extract can ameliorate depressive-like behaviors in rats and, if so, the potential mechanisms underlying its effects. The investigation will involve a series of behavioral tests designed to assess mood and depressive-like behavior, as well as biochemical assays to explore the impact of the extract on specific neurochemical pathways implicated in depression [11].

2. METHODS

2.1Collection of Plant Material and Extraction

The collected part of plant i.e. roots (TG) were firstly dried, then with the help of blender convert it into powdered form, about 200gm of powdered was subjected it into defatting with the help of petroleum ether, and then subjected to filter with the help of muslin cloth and then filtrate cake was subjected to dried at 50 degree for 400 min in hot air oven in order to remove moisture and make it dry. Take the defatted powdered and afterward exposed to separate with the assistance of Soxhlet mechanical assembly utilizing combination of 40% methanol+ 20% ethanol+ 40%water and the subsequent got arrangement was set in water shower (45 degree C). [12,13,14].

2.2. Preliminary Phytochemical Screening

The methanol extract of *A. spinosus* was screened for the presence of various phytoconstituents like steroids, alkaloids, glycosides, flavonoids, carbohydrates, proteins and phenolic compounds [15,16])

2.3 Animals

Thirty young, Swiss albino mice, weighing between 125 and 140 gm, were procured from IVRI and housed in an animal facility for our research. These creatures are housed in cages constructed of polypropylene for storage

purposes, with sanitary and standard circumstances that include 12 hours of darkness and 12 hours of light. The diet was pellet and libitum of water during the study protocol, which is to say before and after the trial. For better accommodation, the I.A.E.C.SIP-IAEC/014/03/23-approved protocol for the experiment required that the experimental animals be housed in isolation in a designated part of the animal house at least 14 days prior to the commencement of the trial.

2.4. Acute Toxicity Studies

For more accurate dosage calculations, the LD50 in trail animals is estimated using OEC recommendations No-423. With the use of oral-gavage, we gave extracts to test animals in doses ranging from 5,50,300, and 2000 mg/kg for the purpose of determining the most effective dosage. For this, we choose a trio of animals (often females) and administer the dosage. It takes around 2-4 stages to determine the acute toxicity of the test ingredient in the extract, and these procedures depend on the mortality and morbidity of test animals. At least 15 days following dosage were necessary for the observation period in this investigation. to evaluate acute toxicity. Every set of six trial animals got 2000 mg/kg of extract, and the trial animals underwent observation for 1, 2, 4, 8 and 24 hours. [17,18,19].

2.5. Antidepressant Activity

A total of thirty experimental animals were employed, with five groups of six animals each being randomly assigned to the experimental animals.;

Group 1. Control group: Animals in this group were fed the standard diet that is used in research facilities, which is to say that the vehicle that was supplied to them was an n-saline solution.

Group 2. In1ducing a1gent; Corticosterone 40mg/kg

Group 3 Extract dose 1st (200mg/kg); Exp1erimental an1imals o1f thi1s gr1oup recei1ved ex1tract o1f Plan1t abo1ut 200mg/kg+. Corticosterone 40mg/kg

Group 4 Extract dose 2nd (400mg/kg): Exp1erimental an1imals o1f thi1s gr1oup recei1ved ex1tract o1f Plan1t abo1ut 400mg/kg+. Corticosterone 40mg/kg

Group 5. Standard drug i.e., Imipramine (2mg/kg) + Inducing agent Corticosterone 40mg/kg.

2.5.1. Forced Swim Test

For the forced swim test (FST), Rats of either sex were individually forced to swim in an open cylindrical container (diameter 10 cm, height 25 cm) containing 19 cm of water at 25±1°c. Treatment was given 60min prior to study as described by study design. All animals were forced to swim for 6 min and the duration of immobility was observed and measured during the final 4 min interval of the test. Each mouse was judged to be immobile when it ceased struggling and remained floating motionless in the water, making only those movements to keep its head above water. A decrease in the duration of immobility is indicative of an antidepressant like effect [20,21].

2.5.2. Tail Suspension Test

The tail suspension method used in this study was similar to those described by Steru et al., (1985). Treatment was given 60 min prior to study as described by study design. Mice were suspended on the edge of the table, 50 cm above the floor, with the help of adhesive tape placed approximately 1 cm from the tip of the tail. The total duration of immobility induced by tail suspension was recorded during a 6 min of the 10 min period. Animal was considered to be immobile when it did not show any movement of the body, hanged passively and completely motionless [22].

2.6. Statistical Analysis

All the values were expressed as Mean ± S.E.M. the results were analyzed statistically by one-way ANOVA followed by Dunnett Multiple comparison test, $P<0.05$ was considered significant.

3. Results

3.1. Preliminary Phytochemical Screening

On preliminary phytochemical analysis of Tectona grandis showed the presence of flavonoids, saponins, glycosides, terpenoids amino acids, alkaloids, carbohydrates, phenolic compounds and proteins.

Table 1: Preliminary phytochemical screening results

S. N0.	Test Performed	Ethanolic extract
1).	Alkaloids	+
2).	Saponins foam investigation	+
3).	Steroids	+
4).	Carbohydrates	+
5).	Anthriaquin0ne Glyc0sides	+
6).	Cardiac Glycosides	+
7).	Tannins	+
8).	Proteins	+
9).	Flavonoids Teist	+
10).	Cynogenetic Glycosides	--

3.2. Acute Toxicity Studies

Alcoholic extract of Tectona grandis showed no behavioural changes nor mortality at dose 2000 mg/kg.

3.3. Antidepressant Activity

The antidepressant effects of alcoholic extract of *Tectona grandis* (200 and 400 mg/kg) and imipramine were studied by observing the changes in the duration of immobility in the two models: Forced swim test (FST) and Tail suspension test (TST). In both TST and FST, TG 200 and 400 mg/kg, p.o. produced significant reduction ($p<0.01$) in the immobility period when compared with that of control group animals that received only the vehicle. The results are tabulated in Table 2.

TABLE 2: DESCRIPTIVE STATISTICS OF FORCE SWIM TEST

S. No.	Dose	Forced Swim test Duration of Immobility (Sec)
Control Group 1	10 ml/kg	140.33±6.6
Inducing Agent (Corticosterone)	40 mg/kg	40.23 ± 5.6
Test Group 1(TG)+ Inducing Agent	200 mg/kg	125.00±0.577*
Test Group 2(TG)	400 mg/kg	135.66±0.145*
Standard drug i.e. Imipramine (2mg/kg) + Inducing agent Corticosterone 40mg/kg.	2 mg/kg	138.16±1.167*

Evaluation of depressant activity of *Tectona grandis* using estimation of immobility Values are expressed as Mean ± SD (One way ANOVA followed by Dunnett multiple comparison test). * Significant difference at $P< 0.05$ vs. Control group; ** More Significant difference at $P< 0.01$ vs. Control group.

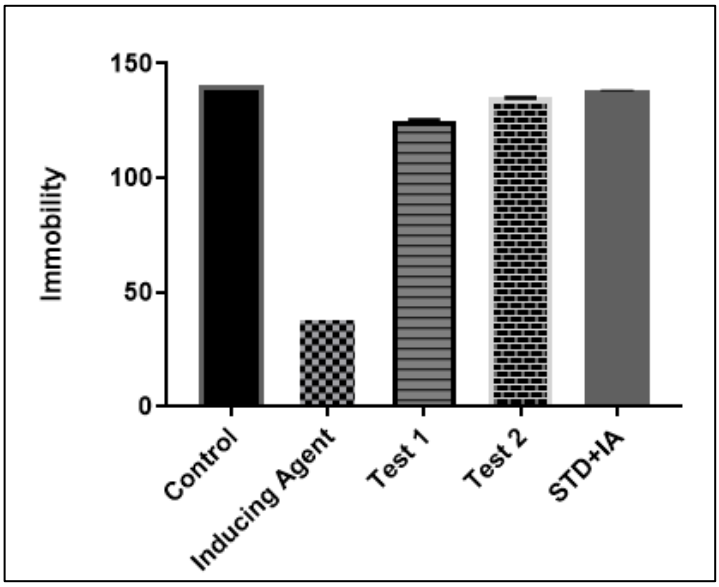

Fig. 1: Behavioural result of Force swim Test.

TABLE 3: DESCRIPTIVE STATISTICS OF TAIL SUSPENSION TEST

S. No.	Dose	Tail Suspension test Duration of Immobility (Sec)
Control: Group 1	10 ml/kg	148.5±56
Inducing Agent (Corticosterone)	40 mg/kg	48.23 ± 5.6
Test Group 1(TG)+ Inducing Agent	200 mg/kg	135.00±0.577*
Test Group 2(TG)	400 mg/kg	143.66±0.145*
Standard drug i.e., Imipramine (2mg/kg) + Inducing agent Corticosterone 40mg/kg.	2 mg/kg	145.16±1.167*

Table 3: Evaluation of depressant activity of *Tectona grandis* using estimation of immobility Values are expressed as Mean ± SD (One way ANOVA followed by Dunnett multiple comparison test). * Significant difference at P< 0.05 vs. Control group; ** More Significant difference at P< 0.01 vs. Control group.

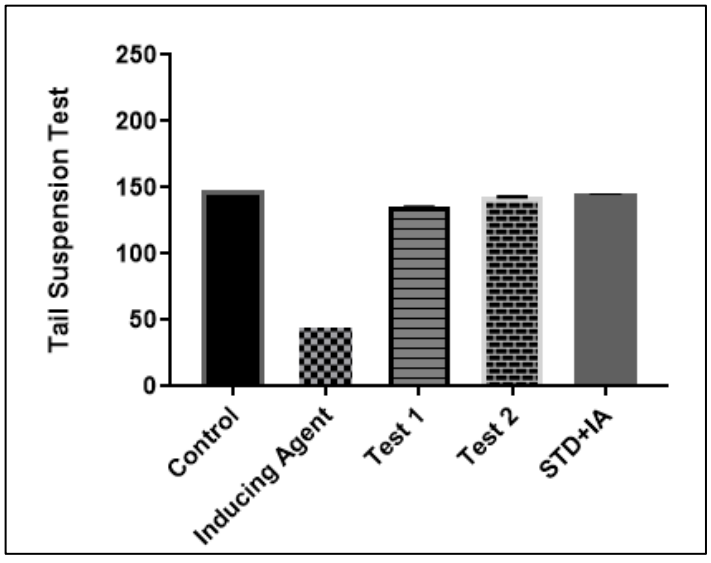

Fig. 2: Showing Behavioural Parameter of Tail Suspension Test.

Histopathology:

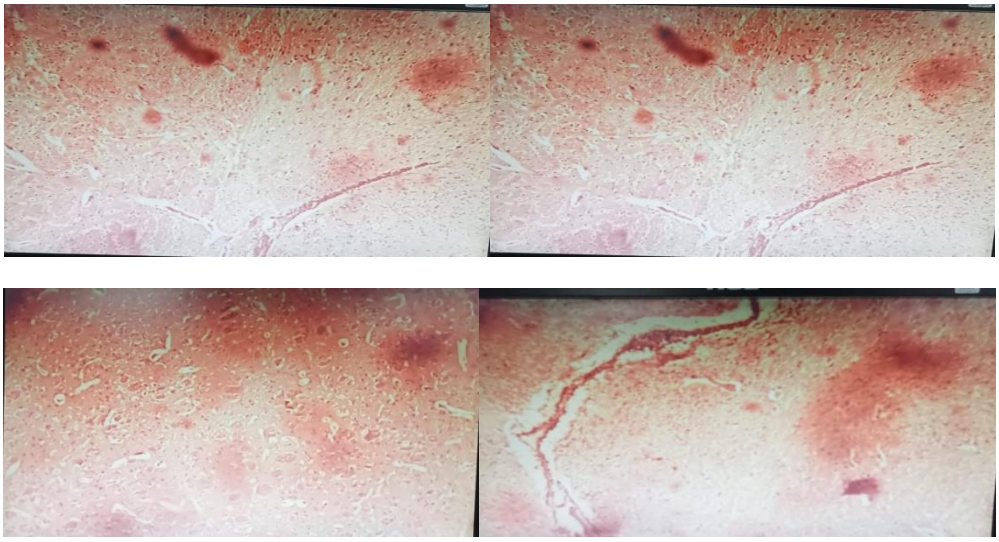

Fig. 3: Showing normal neuron and necrotic neurons.

4. Discussion

Depression is an important psychiatric disorder that affects individuals' quality of life and social relations directly. Depression is characterized by emotional symptoms such as hopelessness, apathy, loss of self-confidence, sense of guilt, indecisiveness, and amotivation, as well as biological symptoms like psychomotor retardation, loss of libido, sleep disturbances, and loss of appetite. When the symptoms are very severe, major depression is considered. Medications such as tricyclic antidepressants (TCAs), selective serotonin reuptake inhibitors (SSRIs), selective reversible inhibitors of monoamine oxidase A (RIMAs), and specific serotonin–noradrenaline reuptake inhibitors (SNRIs) are clinically employed for drug therapy (Fava, 2003). However, these drugs can impose a variety of side-effects including cardiac toxicity, hypopiesia, sexual dysfunction, body weight gain, and sleep disorder [22-25].

In this study, we used two animal models, FST and TST. Both the paradigms are widely accepted behavioural models for assessing pharmacological antidepressant activity [27,28]. Characteristic behaviour scored in these tests is termed immobility, reflecting behavioural despair as seen in human depression [29,30]. In addition, it is well known that many antidepressant drugs are able to reduce the immobility time in rodents [31]. MEAS produced a marked reduction in immobility time at doses of 100 and 200 mg/kg in the rat FST and TST, with a profile comparable to that observed for the classical antidepressant drug ESC and imipramine. FST has not traditionally been viewed as a consistently sensitive model for detecting selective serotonin reuptake inhibitor activity, whereas these antidepressants are generally reported as active in the TST [32].

Moreover, TST is proposed to have a greater pharmacological sensitivity as compared with FST [33,34]. *A. spinosus*, contains amino acids namely, lysine, arginine, histidine, cystine, phenylalanine, leucine, isoleucine, valine, threonine, methionine, tyrosine and tryptophan [35]. These amino acids contribute positively to the antioxidant activity [36]. Amaranthus also reported to contain beta-carotene, thiamine, riboflavin, niacin and ascorbic acid. Carotenoids serve as precursors of vitamin A, show antioxidant activity [37].

Phytochemical analysis showed the presence of Flavonoids and phenolic compounds have been reported to have multiple biological effects such as Central nervous system disorders [38], antioxidant activity [39], analgesic [40], anti-inflammatory, inhibition of mast cell histamine release antiulcerogenic, cytotoxic, antihypertensive, hypolipidemic, antiplatelet and neurodegenerative diseases. A study from Noldner and Schotz (2002) has indicated that rutin is essential for the antidepressant activity of *Hypericum perforatum* extract, a plant used in many countries for the treatment of mild to moderate forms of depression [41].

4. Conclusion

The present study provides the first evidence indicating that methanolic extract of Tectona Grandis showed significant antidepressant activity in TST and FST models of depression. Further research is required to know the mechanism of its action.

Conflict of Interest

Authors declares no conflict of interest.

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