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Pharmacological Investigation and Evaluation of Antidepressant Activity of *Lavandula angustifolia*

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Abstract:
Our goal is to investigate the possibilities of medicinal plants in the treatment of depression because all of the synthetic medications now available for this condition have a variety of negative side effects linked to troublesome interactions. Because *Lavandula angustifolia* leaves contain more phytochemical elements, the current study suggests that they have more effective activity for managing depression. This finding supports the suggested work. When *Lavandula angustifolia* leaves were treated with MeOH at effective doses of 150–300 mg, all animals in various groups showed a substantial change in immobility time. When compared to antidepressants like amitriptyline and fluoxetine, the greatest benefit was shown at 300 mg/kg b.wt., which reduced immobility time. Thus, it was determined that the ethanolic extract of *Lavandula angustifolia* leaves, at an effective dose supported by the current investigation, may cure depression in both humans and mice.

Keywords *Lavandula angustifolia*, Amitriptyline and Fluoxetine, Depression

1. Introduction

Everybody experiences sadness from time to time. However, these emotions often pass within a few days. Depression is painful and interferes with day-to-day living for you and others around you. These days, depression is one of the prevalent but dangerous conditions. Depression is the fourth most common cause of sickness worldwide, affecting 17–20% of the population and causing serious social and economic issues. Thankfully, there are treatments for it as well. Both mental and physical issues may become more likely as a result. It may also interfere with your day-to-day activities, such as working or living at home [1-6].

Symptoms of depression can ranges from mild to severe and it includes:

- Feelings of sadness
- Suicidal thoughts
- Loss of appetite
- Irregular sleep pattern
- Loss of energy
- Feeling of hopelessness and despair
- loss of interest and pleasure
- loss of confidence or feeling guilt
- Poor concentration

It has a recognisable pattern and is also referred to as endogenous depression. It manifests in early adulthood, is unrelated to outside stressors, and is characterised with manic and fluctuating depressive symptoms. According to the World Health Organisation, mental health is a condition of well-being in which a person recognises their own potential, is able to manage everyday stressors, is able to work well, and may even be able to give back to their society. This definition of mental health includes good emotions and functioning as essential components of mental well-being, in addition to the absence of mental disease [7].

It is challenging to reconcile the idea that well-being is a crucial component of mental health with the numerous difficult life circumstances in which it may even be unhealthy. For example, most people would view as mentally unhealthy a person who is experiencing a state of well-being while killing multiple people during a war, and they would view as healthy a person who is feeling desperate after losing their job in a situation where there are few opportunities for employment [8].

Numerous academics use the idea of mental health, which specifies three elements of mental health emotional, psychological, and social well-being—and incorporates both essential elements of the WHO definition, namely, happy emotions and positive job productivity [9-10].

Social well-being refers to positive and productive social functioning, such as social contribution, social integration, social actualization, and social coherence; psychological well-being includes personality traits, good relationships and communication skills, and a happy and contented life; and emotional well-being includes happiness, positivity, interest in life, and contentment [11-15].

2. Material and Methods

Collection and authentication of plant material: The selected plant material *Lavandula angustifolia* leaves were collected from local area of Indore, (M. P.) India, and authenticated by botanist.

Macroscopic studies: The selected crude drugs were subjected to studies organoleptic characters viz., color, odour, appearance, taste, texture etc.

Physicochemical Evaluation: Physiochemical qualities, for example, ash values and extractive values were researched for chose plant as the official strategies and as per WHO guidelines. Ash values (Total ash, Acid insoluble ash and Water-soluble ash), Extractive values, Loss on drying and pH were determined for *Lavandula angustifolia* leaves.

The following Physicochemical analysis was investigated for the powder drug.

Determine of ash: The ash remaining after the ignition of medicinal plant material is determined by 3 different methods which measure total ash, acid insoluble ash, and water-soluble ash.

A. Total ash:

Procedure: Powdered dried, 2 g weight in a silica crucible and incinerate at temperature not more than 450°C until free from carbon, after that cooled and re-weighed. Proportion of ash was calculated with position to the air-dried drug. The cooled crucible was re-weighed to get the total ash and afterward the ash was use for recognized the acid insoluble ash and water dissolvable ash. The total ash was determined by taking the air-dried drug as standard. The experiment was performed in triplicate.

Calculation: Total Ash% = W2-W1/W x 100

W = weight of sample W1 = weight of empty crucible

W2 = final weight of crucible

B. Determination of acid insoluble ash: It is attain after boiling the total ash with dilute hydrochloric acid solution, and filtered the residual insoluble substance. It was dealings with the amount of silica present, especially as sand and siliceous earth.

Procedure: The ash created in total ash test method was boiled with 25 ml of 2M hydrochloric acid solution for 5 minutes. The insoluble matter was collected on ash less filter paper. The ash obtained was washed with hot water and filter paper was burnt to a constant weight in a muffle furnace. The percentage of acid-insoluble ash was calculated with reference to the air-dried powered drug (60#). The experiment was performed in triplicate.

Calculation: Acid insoluble Ash% = W2-W1/W x 100

Where, W = weight of sample
W1 = weight of empty crucible
W2 = final weight of crucible

C. Determination of water-soluble ash: It is the difference in weight between the total ash and the residue after management of the total ash with water

Procedure: The ash formed in above test (total ash) was boiled for 5 min with 25 ml of water. The insoluble matter was filtered through ash less filter paper and this filter paper and insoluble matter on it was ignited in furnace till constant weight. The weight of water-soluble ash was calculated. The experiment was performed in triplicate.

Calculation: Water soluble Ash% = W2-W1/W x 100

Where, W = weight of sample
W1 = weight of empty crucible
W2 = final weight of crucible

Determination of loss on drying: 10 gm of drug powdered material was taken in a petridish and dried at 105ºC till constant weight was obtained. The value of loss on drying was calculated in percentage as following formulae. The experiment was performed in triplicate.

Identification of moisture content: The moisture content of crude drug was calculated by loss of weight on drying strategy. The dried coarse powdered medication (5 g) was taken in a tarred petri dish and kept in ovenat 105°C till stable weight was acquired. The amount of moisture content acquire in test was determined as a kind of perspective to the air dried medication.

Determination of extractive values:

(a) Determination of alcohol soluble extractive value: Air-dried 4gm powdered material of *Lavandula angustifolia* leaves, were macerated with 100ml of alcohol in a closed flask for 24h, shaking frequently at an interval of 6h. It was then allowed to stand for 18h and filtered rapidly to prevent any loss during evaporation. Take 25 ml filtrate was evaporated to dryness in a porcelain dish and dried at 105ºC to a constant weight. The percentage of alcohol soluble extractive was calculated with reference to the air-dried drug.

(b) Determination of water-soluble extractive value: Air-dried 4gm powdered material of *Lavandula angustifolia* leaves was taken and soaked in 100ml water in a closed flask for 1h with frequently shaking. It was then boiled gently for 1h on water bath; cooled, weighed and readjusted the weight. 25ml filtrate was evaporated to dryness in a porcelain dish and dried at 105ºC to a constant weight. The percentage of water-soluble extractive was calculated with reference to the air-dried powered drug (60#).

Extraction Process of Drug: Extraction includes partition of bioactive segment of the plant tissues from the latent moiety by utilizing specific solvents in standard extraction systems. Plant herbs were extracted successively with hexane, and ethanol utilizing maceration method of extraction. The totally dried leaves of *Lavandula angustifolia* were coarsely powdered and afterward extracted with non-polar solvent hexane for defatting of plant material. Leaves powder (100g) were stuffed in vessel and kept with hexane for 24 hours and procedure was repeated till complete extraction. The plant material then kept with ethanol for 24 hours and procedure was repeated till complete extraction. The obtained ethanol extract was filtered and concentrated on rotatry evaporator to get ethanol extract.

Prelimnary phytochemical analysis of extracts: Qualitative test as Phytochemical examination of any plant species is a vital procedure as it give the starter data about presence of different chemical constituents and furthermore gives further possibilities of the specific plant species in its future research examinations. The extracts acquired by extraction methods were exposed to different chemical tests to recognize the presence of a class of chemical constituents.

In-vivo pharmacological screening (Anti-Depressant activity)

Drugs and Chemicals: All the chemicals employed in these investigations were of highest purity and procured from Sigma company USA, Merck Germany, Sisco Research Laboratory, Mumbai, Qualigens Mumbai, Across Organics Mumbai, Spectrochem, Mumbai or S.D. Fine chemicals Mumbai. All the organic solvents were of AR grade. Spectrophotometer (Schimatzu model UV 1601) double beam, spectroflurometer (Elico model), refrigerated

super speed centrifuge (Sorvall RC-5B model), light microscope (Lynx, Lawrence and Mayo) was used for the preparation and estimation of biological samples.

Experimental animals: The animal experiments, male mice weighing about 100-125g were used. These mice can be able to access laboratory feed and water under standard laboratory conditions. The animals used in the present study were maintained in accordance with the guidelines of National Institute of Nutrition, India and approved by Institutional Animal Ethics Committee (IAEC). Experiments performed by an observer who was unaware of each treatment were carried out between 1- 3p.m. For the behavioral test, different doses of the extract were separately suspended in a vehicle comprising 1% (w/v) tween 20 in distilled water and a standard drug (amitriptyline and fluoxetine) were given by gastric gavage once a day over a period of 1,3, 7, 14 and 21 days. Behavioral test was conducted 1 hour after the last treatment/administration.

A. Forced swimming test (FST): Animal groups: The activity was performed with 48 total mice. We were randomly divided into 6 groups, each group having 8 mice. The mice of each group were treated accordingly treatment given in Table 1 and treated as follows: Group 1 act as normal control and Group 2 have tween-20 suspensions and act as experimental control (FST group). Group 3-5 were orally administered with various doses of ethanol extract of *Lavandula angustifolia* having three different doses. Group 3 treated as 100 mg extract/kg of body weight, Group 4 treated as 200 mg extract/kg of body weight, Group 5 treated as 300 mg extract/kg of body weight. The animals present in Group 6 and 7 received standard anti- depressant drug-amitriptyline and fluoxetine (10 mg/kg body weight).

Experiment design: The FST conducted in mice as all the groups of mice were subjected to swimming test except group 1 in a cylindrical glass aquarium (50 x 30 cm diameter), containing 25±2ºC water. Mice were allowed to swim for 6 min and the duration of immobility was measured during the final 4 min interval of the test using a video tracking system. Immobility period was regarded as the time spent by the mouse floating in the water without struggling and making only those movements necessary to keep its head above the water. Following swimming sessions, they were then towel dried. In order to determine the time-dependent effects on immobility time, oral treatments with LAEOH for 1, 3, 7, 14 and 21 consecutive days were investigated.

Table 1: Experiment animal groups (FST)

Animal groups	Treatment
Group 1	Normal control
Group 2	Tween-20 suspensions + FST
Group 3	LAEOH (100 mg/kg b wt.) + FST
Group 4	LAEOH (200 mg/kg b wt.) + FST
Group 5	LAEOH (300 mg/kg b wt.) + FST
Group 6	Amitriptyline (10 mg/kg b wt.) + FST
Group 7	Fluoxetine (10 mg/kg b wt.) + FST

B. Tail suspension test (TST): Animal groups: The activity was performed with 48 total mice. We were randomly divided into 6 groups, each group having 8 mice. The mice of each group were treated accordingly treatment given in Table 2 and treated as follows: Group 1 act as normal control and Group 2 have tween-20 suspensions and act as experimental control (TST group). Group 3-5 were orally administered with various doses of ethanol extract of *Lavandula angustifolia* having three different doses. Group 3 treated as 100 mg extract/kg of body weight, Group 4 treated as 200 mg extract/kg of body weight, Group 5 treated as 300 mg extract/kg of body weight. The animals present in Group 6 and 7 received standard anti- depressant drug-amitriptyline and fluoxetine (10 mg/kg body weight).

Table 2: Experiment of animal groups (TST)

Animal groups	Treatment
Group 1	Normal control

Group 2	Tween-20 suspensions + TST
Group 3	LAEOH (75mg/kg b wt.) + TST
Group 4	LAEOH (150mg/kg b wt.) + TST
Group 5	LAEOH (300mg/kg b wt.) + FST
Group 6	Amitriptyline (10mg/kg b wt.) + TST
Group 7	Fluoxetine (10mg/kg b wt.) + TST

Experiment design: A box having each wall side with 35cm was used for the tail suspension test. The front surface of the apparatus was open and each mouse was suspended by fixing the tail in the centre of the upper surface using a tail hanger and non-irritant adhesive tape with the head 5 cm to the bottom. The experiment was performed in darkened room with minimal background noise for duration of 5 min. The total duration of immobility (total immobility time) was observed and measured during the final 4 min interval of the test period. All test sessions were recorded by a video camera positioned directly above the box. Mice were considered immobile only when they hung passively and completely motionless.

C. Elevated plus maze test: Elevated plus maze test (EPMT) is most broadly utilized as well as approved method to quantify anxiety in animal models. Mechanical assembly comprised of 4 arms of which 2 were remained open along with 2 shut. Open arms (35 cm2 x 5 cm2) were crossed with shut arms (35 cm3 x 5 cm3 x 20 cm3) at an inside point (5 cm2 x 5 cm2). Behavioral testing was performed under dim light in a noise-attenuated room. Animals were treated with separate treatment groups and following half-hour, they were exclusively put on EPM device at the middle, confronting one of the shut arms. Duration (in a moment or 2) spent by every one of the animal on open and shut arms was noted for 300 seconds. Evaluation of the anxiolytic like effects was based on behavioral measures of the time spent in the open and closed arms or in the center platform (expressed as a percentage of total test time), and on the number of open arm entries (OAE). An entry into a specific arm was scored when a mouse placed all four paws into the arm. The other parameters studied were the number of head dipping (DIP, exploratory movement of head/shoulders over the sides of the maze), and stretch-attend postures (SAP, exploratory posture in which the mouse stretches forward and retracts to original position without locomoting forward).

3. Results and Discussion

Collection and authentication of plant material: The selected plant material *Lavandula angustifolia* leaves were collected from local area of Indore, (M. P.) India, and authenticated by botanist.

Macroscopic studies: A systematic approach is necessary in pharmacognostic study, which helps in confirmation and determination of identity, purity and quality of a crude drug. The selected crude drugs were subjected to studies organoleptic characters viz., color, odour, appearance, taste, texture etc. *Lavandula angustifolia* leaves occur as short, smooth, compound, ovate-lanceolate, acute, symmetrical, entire, pinnate, opposite, sweet smelling, characteristics or bitter in taste and varies in length, Lawsone is mainly present in the marginal vein or petiole in large quantity. The results of organoleptic studies are presented.

The leaf of *Lavandula angustifolia* L. is short, smooth, compound, ovate-lanceolate, acute, symmetrical, entire, pinnate, opposite, sweet smelling, characteristics or bitter in taste and varies in length, Lawsone is mainly present in the marginal vein or petiole in large quantity.

Table 3: Organoleptic identification of *Lavandula angustifolia* leaves

S. No.	Parameters	Observations *Lavandula angustifolia* leaves
1	Shape	ovate-lanceolate
2	Odour	sweet smelling
3	Taste	Bitter and characteristics
4	Colour	Green
5	Foreign organic matter	No adulterants have been found

Physicochemical Evaluation: Physicochemical parameter such as Ash values (Total ash, Acid insoluble ash and Water soluble ash), Extractive values, Loss on drying and pH of all selected plant drugs were performed. Ash values of crude drug provide an idea about the inorganic composition or earthy matter and other impurities present in drug. All parameters of selected drugs found within the limit as per API. Results of physicochemical parameters are shown in **Table 4.**

Table 4: Physicochemical parameters of *Lavandula angustifolia* leaves

S. No.	Physicochemical parameter values (% w/w)	*Lavandula angustifolia* leaves
1	Total ash	12.09
2	Water soluble ash	4.29
3	Acid insoluble ash	2.91
4	Loss on drying	4.84
5	Foreign organic matter determination	1.5

The extractive values are mainly useful for the determination of adulterated or exhausted drug. Physicochemical parameters are total ash (12.09 %), acid insoluble ash (2.91 %), and water soluble ash (4.29 %). Loss on drying was found to be (4.84 %) w/w. Alcohol soluble extractive value and aqueous extractive value were 4.21 % w/w and 5.48 % w/w respectively. Results of extractive values are shown in **Table 5.**

Table 5: Solvent extractive values (%w/w) of *Lavandula angustifolia* leaves

S. No.	Name of extract	Extractive value *Lavandula angustifolia*
1	Alcohol soluble extractive value	4.21 % w/w
2	Water soluble extractive value	5.48 % w/w

Extraction process of drug: Methanol extract of *Lavandula angustifolia* leaves drugs obtained by maceration method after defatting of leaves with hexane. Defatting of leaves with nonpolar solvent cause removal of chlorophyll and fatty material which can further hindered the activity of plant extract.

Prelimnary phytochemical analysis of extracts: In order to determine whether secondary metabolites (such as alkaloids, glycosides, tannins, flavonoids, sterols, fats, oils, phenols, and saponins) were present in the ethanol extract of a specific plant, *Lavandula angustifolia* leaves, that were obtained using the Soxhlet method, were subjected to qualitative phytochemical tests. In the ethanolic extract, there were no saponins, alkaloids, phytosterols, fixed oils, lipids, proteins, amino acids, or volatile oils, but there were carbohydrates, glycosides, tannins, phenolic compounds, gums, and mucilage. The findings are shown in Table 6.

Table 6: Phytochemical analysis of *Lavandula angustifolia* leaves extracts

S. No.	Phytochemical	Indication test	Ethanol extract
1	Alkaloid	Dragendorff test	-
2	Napthoquinon	Juglone test	+
2	Steroid	Salkowaski test	-
3	Carbohydrates	Molish test	+
4	Triterpene	Vanillin-sulphuric acid test	-
5	Tannin	Ferric chloride test	+
6	Glycosides	Keller-killani test	+
7	Protein	Biuret test	-
8	Flavonoid	Shinoda Test	+
9	Saponin	Lead acetate test	-
10	fixed oils, fats		-

Where + is Present and – is Absent

***In-vivo* antidepressant activity (Anti-depressant activity)**

Effect of LOET, amitriptyline and fluoxetine pre-treatment on body weight mice (FST and TST groups): Tables 7 and 8 show how the extract affected the change in body weight. The findings demonstrated that there was no variation in the animals' body weight growth among the groups receiving treatment for one, three, and seven days. Following oral delivery, a small rise in weight gain was noted as the therapy lasted from seven days to two to three weeks or from fourteen to twenty-one days. Mice's weight growth might be equivalent to rats' typical weight rise. It has been verified that the animals' weight was unaffected by the administration of LOET.

Table 7: Effect of LOET, amitriptyline and fluoxetine pre-treatment on body weight in mice (FST groups)

Body weight (g) during different treatment period							
Days	**Groups**						
	Group 1	**Group 2**	**Group 3**	**Group 4**	**Group 5**	**Group 6**	**Group 7**
1	107.8±2.1	106.6±1.5	109.2±2.1	110.5±2.1	108.5±3.6	106.4±1.4	104.3±1.4
3	108.4±1.2	108.8±1.7	111.6±2.5	116.2±1.1	110.5±2.6	107.9±2.1	106.1±1.6
7	110.6±21	111.4±3.2	113.4±3.4	117.4±2.4	111.4±3.8	110.2±2.1	107.5±1.6
14	111.5±1.9	115.4±2.1	116.1±3.3	119.5±3.6	113.3±3.3	111.7±2.1	109.7±2.2
21	114.3±2.1	118.9±2.3	122.8±1.9	121.4±2.1	113.8±2.1	112.8±1.3	112.4±1.2

Values are presented as the mean ± SD (n=8). There were no significant differences at $p<0.05$.

Table 8: Effect of LOET, amitriptyline and fluoxetine pre-treatment on body weight in mice (TST groups)

Body weight (g) during different treatment period							
	Groups						
Days	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**	**Group 6**	**Group 7**
1	102.1±2.2	102.1±11	103.1±1.3	106.1±1.1	103.1±1.6	100.1±1.1	100.3±1.1
3	105.7±1.7	103.8±1.1	105.4±1.2	107.1±2.1	104.2±1.1	100.7±1.5	101.2±1.3
7	108.6±11	105.1±2.2	106.3±1.4	109.1±1.4	105.1±1.3	101.1±1.7	102.1±1.1
14	111.1±1.2	107.3±2.1	106.9±2.3	110.2±2.1	108.7±1.2	102.2±2.2	103.2±1.1
21	115.5±2.3	109.2±1.1	107.2±2.1	112.1±1.1	109.2±1.8	103.2±2.1	104.1±1.1

Values are presented as the mean ± SD (n=8). There were no significant differences at $p<0.05$.

Effect of LOET, amitriptyline and fluoxetine pre-treatment on immobility time in the mice (FST and TST groups): Mice are made to swim in a small area from which they are unable to escape during FST, which causes them to exhibit the immobile behaviour that is characteristic of the condition. Several substances that are therapeutically useful in treating human depression lessen this behaviour, which is indicative of a mood of despair. Similar to the FST, the TST makes animals feel hopeless. This immobility was examined by looking at potential time-dependent effects on immobility time. This immobility is known as behavioural despair in animals and is also acknowledged as a condition akin to human depression. The standardised application schedule, which was preceded by the appropriate vehicle control application, was used to examine oral treatments with LOET for 1, 3, 7, 14, and 21 consecutive days, respectively.

The FST animals' antidepressant-like performance is demonstrated by a decrease in the amount of time they are immobile. At dosages of 100, 200, and 300 mg/kg, LIEOH treatment significantly decreased the immobility period in mice during the forced swimming test in a dose-dependent manner. The effects of amitriptyline, fluoxetine, and LOET on immobility in mice are shown in Tables 7 and 8, respectively. In mice in FST and TST, the clinical antidepressant effects frequently manifest after long-term therapy. After three and seven days of therapy, the results showed a small decrease in immobility time, which was non-significant at $p<0.05$. Following LOET pre-treatment for 14 and 21 days, the mice were able to swim.

When compared to stress control, the length of immobility was shortened, and this effect was shown with the traditional antidepressants amitriptyline and fluoxetine. Following 14 days of oral therapy, LOET at 300 mg/kg b.

wt. showed a substantial reduction in the duration of immobility. There was a notable therapeutic effect for dosage in immobility time following a 21-day course of LOET. When compared to antidepressants like amitriptyline and fluoxetine, the greatest benefit was shown at 300 mg/kg b.wt., which reduced immobility time.

Table 9: Effect of LOET, amitriptyline and fluoxetine pre-treatment on immobility time in the mice (FST groups)

Group	Dose mg/ kg b.wt	Duration of immobility (s) Days				
		1	3	7	14	21
Group 1	Normal control	-	-	-	-	-
Group 2	Tween-20 suspensions + FST	112.1±7.1	102.1±3.1	108.1±6.3	103.4±5.1	105.4±3.9
Group 3	LOET (100 mg/kg b wt.) + FST	103.4±6.6	87.1±4.1[a]	89.1±3.6	75.4± 4.1[a]	66.2±3.6[a]
Group 4	LOET (200 mg/kg b wt.) + FST	98.2±8.3	84.5±3.3[a]	76.2±4.3[a]	59.7±5.1[a]	57.4±5.7[a]
Group 5	LOET (300 mg/kg b wt.) + FST	89.3±86.1[a]	76.1±4.1[b]	66.1±4.7[b]	41.8±2.1[b]	24.2±4.6[b]
Group 6	Amitriptyline (10mg/kg b wt.) + FST	73.1±7.2[b]	66.3±6.1[c]	56.2±5.1[c]	29.2±5.4[b]	15.4±2.9[c]
Group 7	Fluoxetine (10mg/kg b wt.) + FST	79.4±9.2[a]	69.6±3.1[b]	67.1±3.1[b]	36.0±4.6[c]	22.5±2.2[b]

Values are presented as the mean ± SD (n=8). Values bearing different superscripts in the same column are significantly different ($p<0.05$) (ANOVA).

Table 10: Effect of LOET, amitriptyline and fluoxetine pre-treatment on immobility time in the mice (TST groups)

Group	Dose mg/ kg b.wt	Duration of immobility (s) Days				
		1	3	7	14	21
Group 1	Normal control					
Group 2	Tween-20 suspensions + TST	93.3±3.9	92.7±6.1	93.4±4.3	91.4±3.7	89.1±5.7
Group 3	LOET (100 mg/kg b wt.) + TST	87.5±3.6	85.6±6.8[a]	84.4±4.3	78.7±4.7[a]	75.2±1.7[a]
Group 4	LOET (200 mg/kg b wt.) + TST	86.1±3.1	77.8±6.6[a]	73.7±3.2	74.6±3.6[a]	69.6±2.2[a]
Group 5	LOET (300 mg/kg b wt.) + FST	86.6±3.4	71.4±5.1[b]	66.1±4.4[a]	65.8± 4.7[b]	60.2± 3.7[b]
Group 6	Amitriptyline (10mg/kg b wt.) + TST	79.5±3.1	67.7±6.4[b]	59.7±3.1[a]	56.4±3.4[b]	51.4±2.4[b]
Group 7	Fluoxetine (10mg/kg b wt.) + TST	74.8±3.6	67.0±4.6[b]	55.4±4.6[a]	49.5±3.7[b]	46.5±4.1[b]

Values are presented as the mean ± SD (n=8). Values bearing different superscripts in the same column are significantly different ($p<0.05$) (ANOVA).

Elevated plus maze test: In animal models, the most widely used and authorised technique for measuring anxiety is the elevated plus maze test (EPMT). The number of open arm entries (OAE) and behavioural measurements of the amount of time spent on the centre platform or in the open and closed arms (as a percentage of the total test time) were used to evaluate the anxiolytic-like effects. When a mouse inserted all four paws into an arm, it was considered an admission into that arm. The amount of head dips (DIP, exploratory movement of head/shoulders over the maze's sides) and stretch-attend postures (SAP, exploratory posture in which the mouse extends forward and retracts to its initial position without locomoting forward) were the other metrics that were examined.

There was a reduction in the duration of immobility started compared with stress control and the effect was observed with the classical anti-depressant drug fluoxetine and amitriptyline. LIEOH at 300 mg/kg b. wt. exhibited significant decrease in immobility duration after oral treatment for 14-days.

Table 11: Effect of LOET, on time spent in open arms and time spent in closed arms in elevated plus maze model

Group	Dose mg/ kg b.wt	Time Spent in Open Arms (s)	Time Spent in Closed Arms (s)
Group 1	Normal control	32.15±3.05	216.17±3.11
Group 2	Tween-20 suspensions + TST	101±7.92	189.04±4.19
Group 3	LOET (100 mg/kg b wt.) + TST	51.02±4.12	241.21±2.14

Group 4	LOET (200 mg/kg b wt.) + TST	71.02±5.02	210.11±3.84
Group 5	LOET (300 mg/kg b wt.) + FST	93.04±6.02	207.14±4.24

Values are presented as the mean ± SD (n=8). Values bearing different superscripts in the same column are significantly different ($p<0.05$) (ANOVA).

5. Summary and conclusion

The biochemical and emotional aspects of mental sadness are also linked to symptoms including mystery, pessimism and apathy, low self-esteem that includes feelings of guilt, inadequacy, and ugliness, indecision, and lack of desire. Changes in monoamine neurotransmitters, particularly dopamine, serotonin, and adrenaline, are reflected in the symptoms of major depressive disorder. There may also be a number of drug-drug interactions. These circumstances open the door to using medicinal plants as an alternate therapy for depression. Our goal is to investigate the possibilities of medicinal plants in the treatment of depression because all of the synthetic medications now available for this condition have a variety of negative side effects linked to troublesome interactions.

Because *Lavandula angustifolia* leaves contain more phytochemical elements, the current study suggests that they have more effective activity for managing depression. This finding supports the suggested work. When *Lavandula angustifolia* leaves were treated with MeOH at effective doses of 150–300 mg, all animals in various groups showed a substantial change in immobility time. When compared to antidepressants like amitriptyline and fluoxetine, the greatest benefit was shown at 300 mg/kg b.wt., which reduced immobility time. Thus, it was determined that the ethanolic extract of *Lavandula angustifolia* leaves, at an effective dose supported by the current investigation, may cure depression in both humans and mice.

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