

BEHAVIORAL AND PHYTOCHEMICAL STUDY OF *VACHELLIA LEUCOPHLOEA*: A PROMISING HERBAL SOLUTION FOR MANAGING DEPRESSION

Khare Mayuri^{1*}, Sonvane S.M.¹, Satpute K. L.¹, Wadulkar R.D.¹, Shaikh.M.H.¹

¹Department of Pharmacology, Dayanand education Society's, Dayanand College of Pharmacy,
Latur-413512, Maharashtra, India

***Corresponding Author,**

Khare Mayuri Pandurang,
Department of Pharmacology,
Dayanand education Society's,
Dayanand College of Pharmacy, Latur
413512, Maharashtra, India

Email: kharemayuri45@gmail.com

ABSTRACT:

Context: Depression needs safer alternatives to standard treatments.

Aim: To assess the antidepressant potential of *Vachellia leucophloea* ethanolic extract (EEVL) in mice.

Methods: Swiss albino mice received distilled water, imipramine (10 mg/kg), or EEVL (100/200 mg/kg) for seven days. TST and FST were used to evaluate effects.

Results: EEVL significantly reduced immobility, especially at 200 mg/kg comparable to imipramine.

Conclusion: EEVL shows promising antidepressant-like activity and merits further research.

Keywords: Ethanolic Extract of *Vachellia Leucophloea* (EEVL), Tail Suspension Test (TST), Forced Swim Test (FST).

How to cite this article: Khare Mayuri^{1*} Sonvane S.M.¹ Satpute K. L.¹ Wadulkar R.D.¹ Shaikh.M.H.¹. BEHAVIORAL AND PHYTOCHEMICAL STUDY OF *VACHELLIA LEUCOPHLOEA*: A PROMISING HERBAL SOLUTION FOR MANAGING DEPRESSION. Int J Drug Deliv Technol. 2026;16(85s):774-781. DOI: 10.25258/ijddt.16.85s.77.

INTRODUCTION

The brain is a complex organ that regulates many body systems, such as respiration, appetite, body temperature, sensation, memory, emotions, thinking processes and motor skills. It plays a crucial role in processing sensory data, retaining memories and managing movements [1]. The World Health Organization (WHO) defines depression as a condition marked by feelings of guilt, sorrow, disrupted sleep or appetite, a lack of interest in activities, fatigue and difficulty concentrating [2]. As per WHO (2022) statistics, approximately 280 million individuals worldwide are affected by depression, with women being 50% more likely to be diagnosed than men. Alarmingly, over 10% of pregnant women report experiencing depressive symptoms [3]. The National Mental Health Survey (NMHS) of 2015-16 estimated the lifetime prevalence of depressive disorders at 5.25%, with a current prevalence rate of 2.68% [4]. A survey by Deloitte in the period from 2021 to 2022 indicated that 59% of employees experienced depressive symptoms such as sadness, lack of interest, fatigue, concentration problems and impaired decision-making [5].

There are biochemical, genetic, and environmental factors that affect depression. Several

neurochemicals, hormones, pro-inflammatory cytokines, Glutamate, dopamine, norepinephrine and serotonin are all involved in the development of depression [6].

Vachellia leucophloea also referred to as "safed babul," is a member of the Fabaceae family and has been utilized in traditional Indian medicine. A robust, prickly tree that may grow to a height of about 35 meters is the White Bark Acacia, also called Velvel in Tamil and has white to yellowish-gray bark [7]. The multipurpose tree, which is native to Vietnam, Bangladesh, Myanmar, Pakistan, Thailand, Sri Lanka, Cambodia and India. This plant is used to produce lumber, fiber, medicine, food for humans and animals, and some chemicals. Historically, this tree's many parts utilized for many kinds of illnesses [8].

Vachellia leucophloea's leaves, bark and root were analyzed phytochemically, and the results showed the presence of compounds such as leuco-fisetinidin[9], ferulic acid betulinic acid-3-O- β -D-maltoside [10], oleic acid, β -sitosterol, linoleic acid γ -tocopherol, β -tocopherol, Δ^7 -avenasterol, myricetin[12], quercetin[12], leucophleol[9], leucophleoxol [9], leucoxol [9], catechin [11], O-methyl epicatechin [11], gallic acid, n Hexacosanol, β -amyrin, naphthalene, octacosanol and syringic acid[17]. The

BEHAVIORAL AND PHYTOCHEMICAL STUDY OF VACHELLIA LEUCOPHLOEA: A PROMISING HERBAL SOLUTION FOR MANAGING DEPRESSION

leaves have been used to treat fevers [15] and gastrointestinal problems [16]. They are additionally used externally to treat measles and bleeding piles when mixed with cow's milk [13]. Other potential applications for this tree include the treatment of inflammation [14], cancer [14], leprosy and ophthalmia [12]. Tannins sourced from the bark have been used as astringents to address diarrhea, dysentery, and internal bleeding, while they have also aided in healing wounds, skin disorders, hemorrhoids, and eye problems, and have served as mouth rinses [18]. The tree's trunk and stem provide gum, which is consumed to treat diarrhea and hemorrhoids [21] while its bark decoction is noted for its anticontraceptive properties and in regulating menstrual issues. The bark was employed in Pakistani conventional treatment to treat, multiple circumstances including as dental decay, stomatitis, bronchitis, ulcers, coughing and vomiting [19].

Despite its medicinal potential, the neuropharmacological characteristics of *Vachellia leucophloea* remain under-researched, inspiring the current study to investigate its antidepressant effects in albino mice through the tests of Tail Suspension (TST) and Forced Swim (FST).

MATERIALS AND METHODS:

Profile of an herb

Historically, the plant kingdom has served as a vital source of bioactive compounds used to treat various illnesses. Given that natural remedies generally present fewer side effects compared to synthetic options, medicinal plants have been widely employed for centuries, with many being utilized for healing across numerous cultures. The *Vachellia leucophloea* tree, a large, thorny species, is commonly found in tropical and subtropical regions of South and Southeast Asia. Its unique white bark and expansive umbrella-shaped crown make it easily recognizable. This tree, which blooms naturally in India's semi-arid Aravalli region of Rajasthan, is referred to locally as "Safed Kikkar" or "Raunj" because of the heavy, robust hardwood that is collected for timber and agricultural implements[13,19].

Vernacular Names of *Vachellia Leucophloea*

Table 1: Vernacular Names of *Vachellia Leucophloea* [20]

Country/Language	Vernacular names
English	White babul, Distiller's Acacia,
Hindi	Reonja, Safed Kikkar, Nimbar, Ronjh
Bengali	Safed Babul

Kannada	Bellada, Nayibela, Tapala
Malayalam	Chenkaringali
Marathi	Himvar
Sanskrit	Arimedah, Shwetbarhura
Tamil	Sarai
Telugu	Tella Tum

Taxonomical Classification of *V. Leucophloea*

Table 2: Taxonomical Classification of *V. Leucophloea* [20]

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	Acacia
Species	<i>Vachellia leucophloea</i>



Fig 1 : Flowers of *V. Leucophloea*



Fig 2 : Leaves of *V. Leucophloea*



Fig 3 : Pods of *V.Leucophloea*



Fig 4 : Spines of *V.Leucophloea*



Fig 5 : Stem of *V.Leucophloea*

Collection and Authentication of Plant

The stem bark of *Vachellia leucophloea* was chosen based on a thorough literature review. Fresh bark samples were gathered from the Solapur region in Maharashtra, India. The Department of Botany at Dayanand Science College, Latur, performed authentication of the plant.

Preparation of plant extract

After being harvested, the stem bark of *Vachellia leucophloea* was milled into a coarse powder and permit to dry in the shade for 10 days. This powder was filtered through a 40-mesh sieve to standardize particle size. Approximately 50 g of the dried powder was weighed and extraction was conducted in a Soxhlet apparatus using 500 mL of ethanol for 48 hours at temperatures between 40–45°C. A concentrated dark powder was obtained by evaporating the solvent, and it was kept at room temperature in an amber container that was well sealed [18].



Fig 6 : Hot Continuous Soxhlet Apparatus

Phytochemical Analysis of Plant Extract

The ethanol extract of the *Vachellia leucophloea* stem bark underwent initial phytochemical screening to identify various bioactive constituents through standard methods. The qualitative tests conducted included [22]:

Test for Naphthoquinones (Dam Karrer Test)

A brownish-red color upon treatment with 10% potassium hydroxide (KOH) indicated their presence.

Alkaloids test (Dragendorff's and Mayer's test)

Mayer's test showed a yellow precipitate when mixed with hydrochloric acid and Mayer's reagent, confirming alkaloids, while a red precipitate was seen in Dragendorff's Test.

Flavonoids test (Shinoda test)

Flavonoids were indicated by the formation of bubbles and changing color from orange to red when magnesium ribbon and hydrochloric acid were added.

Phenols test (Ferric chloride test)

Phenolic compounds were detected by a dark green color when mixed with ferric chloride solution.

Terpenoids test (Salkowski test)

The presence of terpenoids was confirmed by a reddish-brown color at the interface when combined with sulfuric acid and chloroform.

Proteins test (Ninhydrin test)

Absence of blue color after heating indicated no proteins were present.

Steroids test (Sulfuric acid test)

A reddish-brown ring with slight green fluorescence suggested the existence of steroids.

Saponins test (Foam test)

BEHAVIORAL AND PHYTOCHEMICAL STUDY OF VACHELLIA LEUCOPHLOEA: A PROMISING HERBAL SOLUTION FOR MANAGING DEPRESSION

Persistent foam for 10 minutes validated an abundance of saponins.

Glycosides test (Legal test)

A greenish-blue color after the addition of glacial acetic acid and sulfuric acid indicated the presence of glycosides.

Experimental animal

Male albino mice weighing 25–35 grams were used in the study; a total of 24 animals had been in bought by Pune at Crystal Biological Solutions, Maharashtra (Reg. Number 2030/PO/RcBiBt/S/18/CCSEA). Throughout the investigation, these mice was treated humanely in accordance with international standards by being housed in polypropylene cages with controlled lighting and dark cycles that last 12 hours, unfettered access to water and a temperature of $25 \pm 3^\circ\text{C}$, 30–70% humidity.

Design of the experimental studies

The animals were split up into 2 test groups, standard group, and control group. Six animals ($n = 6$) were assigned at random to each group. All screening techniques were performed on fresh animals.

Table 3: Design of the experiment regarding each screening technique

Groups	Names	Treatment	Dose/Day
I	Control group	Distilled Water	1ml/kg, Orally
II	Standard	Imipramine	10 mg/kg, Orally
III	Test group-1	EEVL	100mg/kg, Orally
IV	Test group-2	EEVL	200mg/kg, Orally

Evaluation of antidepressant efficacy

Tail Suspension Test

The ethanolic extract, vehicle, or the Standard Antidepressant drug were administered to the mice for seven days. Every mouse was hanged 50 centimeters above the ground through attaching tape 1 centimeter of tape from the tail's tip on seventh day, one hour after treatment. Regarding last 6 min and the duration of immobility was noted. If they stayed still, they were deemed immobile [23].



Fig 7 : Tail Suspension Test

Forced Swim Test

Mice underwent treatment as earlier, with the test performed on the seventh day, an hour post-administration. Each of the mice was raised in a cylindrical container with water at $25 \pm 3^\circ\text{C}$ (10 cm in diameter and 25 cm in height). Mice were deemed immobile when floating passively in the water, with their noses barely above the surface. Immobility time was recorded over the last four minutes of a six-minute session [24].



Fig 8 : Forced Swim Test

Analytical Statistics

For the purpose of statistical analysis, a one-way analysis of Variance was used. These findings have been displayed as mean $\pm$ SEM, and a p-value of less

BEHAVIORAL AND PHYTOCHEMICAL STUDY OF VACHELLIA LEUCOPHLOEA: A PROMISING HERBAL SOLUTION FOR MANAGING DEPRESSION

than 0.05 signifies a noteworthy distinction between the groups. These asterisks (*) within tables and graphs indicate consequences that are statistically significant.

RESULTS:

Preparation of ethanolic extract of EEVL

The extraction of EEVL via the Soxhlet method yielded a percentage calculated as follows, resulting in a yield of 13.21% w/w:

$$\% \text{ yield} = \frac{\text{Weight of Extract Obtained}}{\text{weight of Starting Material}} \times 100$$

Given

- Weight of Coarse Powder (starting material) = 100 g

- Weight of Extract Obtained = 13.21 g

$$\% \text{ yield} = \frac{13.21}{100} \times 100$$

= 13.21%

Preliminary phytochemical analysis

Vachellia leucophloea stem bark ethanolic extract was subjected to phytochemical evaluation, which exhibited no evidence of the proteins but an elevated content of the naphthoquinones, alkaloids, flavonoids, tannins, glycosides and phenols. Table 2 illustrates the results of the investigation.

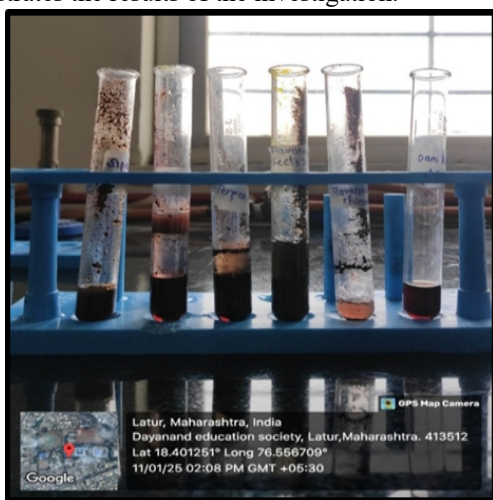


Fig 9 : Phytochemical Screening of *V. Leucophloea*

Table 4: Preliminary phytochemical Screening *Vachellia Leucophloea* Stem Bark

Sr.No	Phytochemical tests	Inference
1	Naphthoquinone test Dam Karrer test	+
2	Alkaloids test Mayer's test- Dragendorff's test-	+
3	Flavonoids test	

	Cyanide test-	+
4	Phenol test Ferric chloride test	+
5	Terpenoids test Salkowski test-	+
6	Protein test Ninhydrin Test-	-
7	Steroids test Sulphuric acid test-	+
8	Saponins test Foam test-	+
9	Glycoside test Legal test-	+

In vivo antidepressant activities

Tail Suspension method

The study treated groups with distilled water (1 ml/kg, orally) as control, imipramine (10 mg/kg, orally) as standard, and low (100 mg/kg, orally) and high doses (200 mg/kg, orally) of EEVL. A significant decrease in immobility was seen at both low and high EEVL dosages in comparison to the control. Table 5 describes the impact of the stem bark extract in detail.

Table 5: Impact of ethanolic stem bark extract of *Vachellia Leucophloea* on immobility duration in Tail Suspension Test

Sr.No	Groups	Treatment	Dose	Duration of Immobility (Seconds)
1	Control group	Distilled Water	1ml/kg	148±13.36
2	Standard	Imipramine	10 mg/kg	93±10.96
3	Test group-1	EEVL	100 mg/kg	94±10.64
4	Test group-2	EEVL	200 mg/kg	81±6.35

BEHAVIORAL AND PHYTOCHEMICAL STUDY OF VACHELLIA LEUCOPHLOEA: A PROMISING HERBAL SOLUTION FOR MANAGING DEPRESSION

The data is displayed as the mean $\pm$ SEM ($n=5$). * $p < 0.05$ contrasted with the control group (ANOVA test).

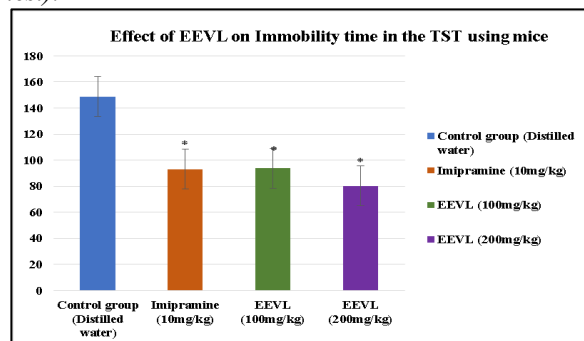


Fig 10: Graphical presentation of Effect of EEVL Immobility Time for the Tail Suspension Test

Similar treatment was given to each participant, and both the low and high doses of EEVL significantly decreased immobility when compared to controls. Table 6 displays an illustration of the results.

Table 6: Influence of *Vachellia Leucophloea* ethanolic stem bark extract on immobility duration in the Forced Swim Test

Sr.No	Groups	Treatment	Dose	Duration of Immobility (Seconds)
1	Control group	Distilled Water	1ml/kg	135 $\pm$ 8.26
2	Standard	Imipramine	10 mg/kg	114 $\pm$ 11.87
3	Test group-1	EEVL	100 mg/kg	73 $\pm$ 9.44
4	Test group-2	EEVL	200 mg/kg	59 $\pm$ 9.64

Data are shown as mean $\pm$ SEM ($n=5$). * $p < 0.05$ in compared with the control group (ANOVA test).

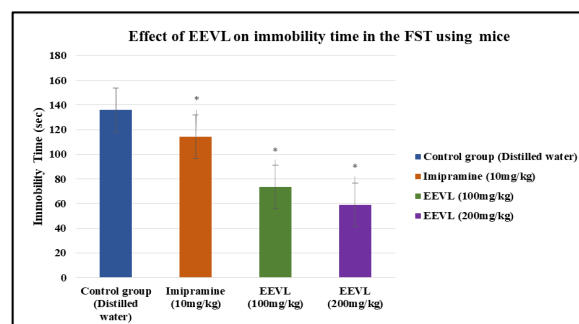


Fig 11: Graphical presentation of Effect of EEVL Immobility Time for the Forced Swim Test

DISCUSSION:

A widespread behavioral disorder, depression strikes roughly 350 million individuals worldwide. Defined by a continuous low mood, decreased interest in enjoyable activities, and both cognitive and physical disruptions, this condition severely undermines one's quality of life. Neurobiologically, depression is associated with a reduction in brain levels of monoamines like serotonin (5-HT), dopamine, and norepinephrine. Most traditional antidepressants work by enhancing monoaminergic activity either by inhibiting monoamine oxidase or blocking reuptake. Although effective, these medications frequently produce side effects such as agitation, insomnia, nausea, and sexual dysfunction, which can compromise long-term patient adherence. Consequently, there is growing interest in exploring plant-based alternatives with promising safety profiles and therapeutic effects.

Herbal medicine has a longstanding history in traditional practices for addressing mental health issues, with numerous plant-derived compounds known to influence the CNS. Among these *Vachellia leucophloea*, an individual belonging to the Fabaceae family that has been traditionally used for a variety of conditions, including mental health disorders.

V. leucophloea, a plant native to Asia and crucial in numerous ancient healthcare practices, is also known as Velvel in Tamil, Arimanja in Ayurveda, and Distiller's Acacia in English. Pharmacological research on various parts of this plant has demonstrated properties such as antidiabetic, analgesic, antipyretic, antioxidant, anticancer, wound healing and anti-inflammatory effects. The ethanolic stem bark extract (EEVL) has been confirmed to include an assortment of biologically active components, including as naphthoquinones, phenols, saponins, alkaloids, glycosides, and flavonoids, as reported by phytochemical investigation. These chemical compounds might assist with controlling the central nervous system.

EEVL's antidepressant qualities were assessed in this study utilizing the Tail Suspension Test (TST) and Forced Swim Test (FST), which both precisely replicate the behavioral despair related to depression in humans. These models are responsive to a wide array of antidepressants and have been extensively used for assessing novel therapeutic agents.

CONCLUSION:

The conclusions of the study demonstrate that the stem bark ethanolic extract of *Vachellia leucophloea* has substantial antidepressant effects, as revealed by minimizing periods of the immobility within behavioral despair models of the depression. In both the FST and the TST, antidepressant-like effects were statistically significant.

These outcomes lend credence to *Vachellia leucophloea*'s traditional use in the treatment of depression and encourage further investigations to isolate its active constituents and understand its specific mechanisms of action. Ongoing pharmacological and clinical research is needed to validate its efficacy and safety in humans and to examine its potential as a plant-based alternative to conventional antidepressants.

ACKNOWLEDGEMENT:

Grateful thanks to the Department of Pharmacology, DES, Dayanand College of Pharmacy, Latur, for their valuable support and encouragement throughout the research work.

CONFLICT OF INTEREST:

The authors declare that there is no any conflict of interest.

REFERENCES:

1. Sabina M, Zakhrokhon T, Gulamovna DB. Nervous System and Its Main Functions. Eurasian Journal of Medical and Natural Sciences. 2024; 4(1-1):61-7.
2. Paiva TC, Soares L, Faria AL. Depression in elderly people. Encyclopedia. 2023 May 29; 3(2):677-86.
3. World Health Organization. Depression [Internet]. Geneva: World Health Organization; 2022 [cited 2025 Jul 13]. Available from: <https://www.who.int/news-room/fact-sheets/detail/depression>.
4. Arvind BA, Gururaj G, Loganathan S, Amudhan S, Varghese M, Benegal V, Rao GN, Kokane AM, BS C, PK D, Ram D. Prevalence and socioeconomic impact of depressive disorders in India: multisite population-based cross-sectional study. BMJ open. 2019 Jun 1; 9(6):e027250.
5. Moss J. The burnout epidemic: The rise of chronic stress and how we can fix it. Harvard Business Press; 2021 Sep 28.
6. Ghallab YK, Elassal OS. Biochemical and neuropharmacology of psychiatric disorders. In Nutrition and Psychiatric Disorders: An Evidence-Based Approach to Understanding the Diet-Brain Connection 2024 Jun 29 (pp. 25-47). Singapore: Springer Nature Singapore.
7. Choudhary S, Tak N, Bissa G, Chouhan B, Choudhary P, Sprent JI, James EK, Gehlot HS. The widely distributed legume tree *Vachellia (Acacia) nilotica subsp. indica* is nodulated by genetically diverse Ensifer strains in India. Symbiosis. 2020 Jan; 80(1):15-31.
8. Comben DF, McCulloch GA, Brown GK, Walter GH. Phylogenetic placement and the timing of diversification in Australia's endemic *Vachellia* (Caesalpinioideae, Mimosoid Clade, Fabaceae) species. Australian systematic botany. 2020 Jan 2; 33(1):103-9.
9. Aprea Rojas MDC, Cano FH, Rodríguez B. Diterpenoids from *Acacia leucophloea*: Revision of the structures of leucophleol and leucophleoxol. J Nat Prod. 2001; 64:899-902.
10. Mishra M, Srivastava SK. Betulinic acid-3-O-β-D-maltoside from *Acacia leucophloea* Wild. Indian J Pharm Sci. 1985; 47:154-155.
11. Ahmed S, Lin HC, Nizam I, Khan NA, Lee SS, Khan NU. A trimeric proanthocyanidin from the bark of *Acacia leucophloea* Willd. Rec Nat Prod. 2014; 8:294-298.
12. Gupta R, Gupta AK, Singla RK, Aiswarya G. Preliminary investigation of antimicrobial property of *Acacia leucophloea* leaves extract. Int J Phytomedicine. 2011; 3:308-311.
13. Sathasivampillai SV, Sebastian PR. Bioactivities of extracts and isolated compounds of *Vachellia leucophloea* (Roxb.) Maslin, Seigler & Ebinger. Bulletin of Biotechnology. 2021; 2(1):16-22.
14. Sowndhararajan K, Santhanam R, Hong S, Jhoo JW, Kim S. Suppressive effects of acetone extract from the stem bark of three *Acacia* species on nitric oxide production in lipopolysaccharide-stimulated RAW 264.7 macrophage cells. Asian Pac J Trop Biomed. 2016; 6(7):658-664.
15. Thirumurthy R, Priya J. Analgesic and antipyretic activity of methanolic extract of *Acacia leucophloea* bark. Int J Res Pharm Pharmther. 2013; 2(2):390-5.
16. Imran I, Hussain L, Zia-Ul-Haq M, Janbaz KH, Gilani AH, De Feo V. Gastrointestinal and respiratory activities of *Acacia leucophloea*. Journal of ethnopharmacology. 2011 Dec 8; 138(3):676-82.
17. Bobade AF. GC-MS and pharmacognostic study of *Acacia Leucophloea* leaves. Int J Pharma Bio Sci. 2020; 11(3):1-9.
18. Suriyamoorthy S, Subramaniam K, Wahab F, Karthikeyan G. Evaluation of wound healing

- activity of *Acacia leucophloea* bark in rats. Rev Bras Farmacogn. 2012 Dec; 22(6):1338–43.
19. Santhiya S, Ragunathan R, Josteena J. Evaluation and characterization of *Vachellia leucophloea* (Roxb.) Maslin, Seigler & Ebinger using phytochemical, antioxidant, GC-MS, antibacterial, and anticancer properties.
 20. Choudhary SU, Meghwal RR, Sankhla IS, Tak NI, Gehlot HS. Molecular characterization and phylogeny of novel diverse nitrogen fixing microsymbionts associated with *Vachellia (Acacia) leucophloea* in arid and semi-arid regions of Rajasthan. Indian for. 2017; 143(3):266-78.
 21. Imran I, Hussain L, Ahmed S, Rasool N, Rasool S, Abbas G, Ali MY. Antiplatelet activity of methanolic extract of *Acacia leucophloea* bark. J Med Plant Res. 2012; 6(26):4185–4188.
 22. Jadhav RT, Kadam VJ, Patil MJ. Pharmacognostic screening and phytochemical evaluation of *Acacia leucophloea* root. Int J Res Ayurveda Pharm. 2011; 2(2):602–5.
 23. Porsolt RD, Le Pichon M, Jalfre M. Depression: A new animal model sensitive to antidepressant treatments. Nature. 1977; 266(5604):730–2.
 24. Steru, L., Chermat, R., Thierry, B., & Simon, P. (1985). The tail suspension test: A new method for screening antidepressants in mice. Psychopharmacology, 85(3), 367-370.