

Available online on 15.08.2025 at <http://jddtonline.info>

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Copyright © 2025 The Author(s): This is an open-access article distributed under the terms of the CC BY-NC 4.0 which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited



Open Access Full Text Article



Research Article

Evaluation of Anticonvulsant Activity of *Streblus asper* Lour Using Experimental Lab Animals

Subhendu Mathur ^{*}, Mangesh Tote , Abhishek Prajapati , Juverya Kazi , Kuldeep Prajapati , Manjari Singh

Department of Pharmacology, Oriental College of Pharmacy, Navi Mumbai, Maharashtra, India, Pin- 400705

Article Info:



Article History:

Received 01 June 2025
Reviewed 06 July 2025
Accepted 03 August 2025
Published 15 August 2025

Cite this article as:

Mathur S, Tote M, Prajapati A, Kazi J, Prajapati K, Singh M, Evaluation of Anticonvulsant Activity of *Streblus asper* Lour Using Experimental Lab Animals, Journal of Drug Delivery and Therapeutics. 2025; 15(8):130-147 DOI: <http://dx.doi.org/10.22270/jddt.v15i8.7327>

*For Correspondence:

Mr. Subhendu Mathur, Department of Pharmacology, Oriental College of Pharmacy, Navi Mumbai, Maharashtra, India, Pin- 400705

Abstract

About 50 million individuals worldwide suffer from epilepsy, with low- and middle-income nations accounting for 80% of cases. Despite the availability of drugs, around 75% of patients do not obtain proper diagnosis or care. Plant-based medicines are becoming more popular as a result of issues including side effects and drug resistance. This study examined the anticonvulsant and antioxidant qualities of ethanolic leaf extract from *Streblus asper* Lour, a plant known for its neuroprotective advantages.

Flavonoids, alkaloids, terpenoids, and phenolics—compounds associated with neuroprotective and antioxidant properties—were identified by phytochemical analysis. Tests conducted in vitro, such as DPPH, H₂O₂ scavenging, phosphomolybdenum, and reducing power assays, showed that the extract had a moderate to strong ability to neutralize free radicals.

The extract was safe at levels up to 2000 mg/kg, according to acute toxicity tests conducted on mice. Pentylentetrazole (PTZ)-induced seizure models and maximum electroshock (MES) were used to assess the effects of anticonvulsants. Comparable to common medications like phenytoin and diazepam, the extract significantly reduced seizure duration and intensity in a dose-dependent manner. Biochemical investigation showed that treated groups had lower levels of malondialdehyde and higher levels of glutathione and catalase.

GC-MS profiling revealed important bioactive substances that could be responsible for the extract's actions, such as phytol and β -caryophyllene. These findings demonstrate the potential of *Streblus asper* as a natural antioxidant and anticonvulsant, indicating that more study may improve its application in the treatment of epilepsy.

Keywords: *Streblus asper*, Anti-convulsant, Maximal Electroshock, Pentylentetrazole model, phytochemical, antioxidant assay.

INTRODUCTION:

The World Health Organization (WHO) estimates that 50 million individuals worldwide suffer from epilepsy, a persistent neurological illness. It is characterized by frequent, spontaneous seizures brought on by aberrant brain electrical discharges. The quality of life can be severely impacted by these seizures, which can range from short-term unconsciousness to severe convulsions. Instead of being a single illness, epilepsy is a collection of conditions with a variety of causes, such as infections, structural anomalies, metabolic problems, and genetic alterations.¹

Because there are frequently little diagnostic resources and treatment options available in low- and middle-income countries (LMICs), the prevalence of epilepsy is particularly high there. The illness is further complicated by cultural stigma and false information, thus it is critical to look for safer, more accessible, and more effective therapeutic alternatives.

Epilepsy's pathogenesis is intricate. Fundamentally, it is caused by an imbalance in the brain's excitatory and inhibitory neurotransmission. Important mechanisms consist of:

- neuronal hyperexcitability, usually brought on by increased glutamatergic (excitatory) transmission or decreased GABAergic (inhibitory) activity.
- Synaptic plasticity, in which long-term shifts in synaptic strength can accelerate the onset of seizures.
- Mutations in voltage-gated sodium, potassium, or calcium channels can result in ion channel dysfunction.
- In neuroinflammation, inflammatory mediators produced by activated glial cells aid in the development of epileptogenesis.
- Excessive reactive oxygen species (ROS) cause oxidative stress, which compromises the integrity of neurons².

Antiepileptic medications (AEDs) are a major component of conventional treatment. These include more recent medications like lamotrigine, levetiracetam, and topiramate, as well as more established ones like phenytoin, carbamazepine, and valproate. AEDs function by:

- Calcium and sodium channels are blocked,
- Increasing GABA levels,
- lowering the excitability of glutamate,
- altering the release of neurotransmitters.

Drug-resistant epilepsy affects almost 30% of patients, and long-term use of AEDs is linked to serious side effects, such as mood disorders, liver toxicity, teratogenic effects, cognitive impairments, and problematic drug interactions. As a result, there is increasing interest in plant-based alternatives that may provide anticonvulsant benefits with fewer side effects.

According to their cause, epileptic seizures are often categorized as follows:

1. generalized seizures, which often result in significant motor symptoms and loss of consciousness and impact both hemispheres of the brain.

Among them are:

- Tonic-clonic seizures, which cause muscles to tighten and then jerk,
 - Tonic seizures, which cause abrupt rigidity,
 - unexpected muscular jerks, or myoclonic seizures, convulsions characterized by abrupt loss of muscular tone,
 - Absence seizures are moments of intense staring.
2. Focal seizures, which may or may not cause consciousness problems, start in a particular area of the brain.

They consist of:

- simple partial seizures (autonomic, sensory, or motor symptoms that are localized),
- partial seizures that are complex (automatisms and disturbed awareness), seizures that are focal to bilateral tonic-clonic (beginning in one part of the brain and spreading to other parts).

Another way to classify seizures is by duration:

- Seizures that are brief last less than two minutes.
- Seizures lasting more than five minutes or recurrent seizures without a break in between that require immediate medical attention are referred to as status epilepticus.

Epilepsy is caused by a number of risk factors, including:

- genetic elements, such as hereditary disorders or family history.
- structural brain injury brought on by strokes, tumors, or trauma.

- neurological disorders like cerebral palsy or Alzheimer's. infections such as neurocysticercosis or meningitis.
- birth issues including low birth weight or hypoxia.
- substance use, such as abusing substances like cocaine or alcohol.
- metabolic abnormalities, such insufficient sodium or hypoglycemia.
- Sleep deprivation and stress can also reduce seizure thresholds³⁻⁵.

One plant of particular interest in the hunt for safer and more natural substitutes is *Streblus asper* Lour., also referred to as the toothbrush tree or Siamese rough bush. This plant is native to Southeast Asia, which includes Thailand, India, and the Philippines. It has been used extensively in traditional Chinese medicine, Ayurveda, and Siddha.

The tree has rough bark, serrated leaves, and yellow fruits. It is small to medium in size and can reach a height of 10 feet. Its name comes from the fact that the fibrous leaves were traditionally used as natural toothbrushes. In addition to dental hygiene, *Streblus asper* has been used to treat a number of illnesses, such as:

- Pain and inflammation (analgesics, anti-inflammatory drugs),
- wounds and infections (antimicrobial and antibacterial),
- Antipyretic for fever; Cancer (antineoplastic and cytotoxic action).

Its anticonvulsant potential has been investigated recently; in particular, the ethanolic leaf extract exhibits encouraging action in animal models of epilepsy.

According to phytochemical investigation, *Streblus asper* has the following components:

- Flavonoids, such as rutin, quercetin, and kaempferol, are well-known for their neuroprotective and antioxidant properties.
- Alkaloids, such as harman alkaloids and strebloside, have analgesic and antiepileptic effects.
- Tannins, such as gallotannins and ellagitannins, have antibacterial and wound-healing properties.
- Strong antioxidants are phenolic chemicals, such as ferulic acid and gallic acid. Steroids and terpenoids, such as lupeol and β -sitosterol, have hepatoprotective and anti-inflammatory properties.
- Essential oils, glycosides, and coumarins all have anticoagulant, antibacterial, and antifungal properties, respectively.

The combination of these substances implies that *Streblus asper* may provide a multimodal treatment for epilepsy by exhibiting neuroprotective, antioxidant, and anticonvulsant properties. Its rich phytochemical makeup encourages more research into it as an alternative or complementary treatment for seizure

disorders, especially in regions with limited resources where access to traditional drugs may be limited⁶⁻¹¹.

MATERIAL AND METHODS:

The leaves of *Streblus asper* Lour. were sourced from Bardhaman district, West Bengal. Pentylene-tetrazole was obtained from SRL laboratories. Dragendorff's reagent, sodium hydroxide, ferric chloride, lead acetate, ninhydrin, concentrated sulfuric acid, and chloroform were obtained from SRL laboratories. All other reagents, solvents, and chemicals employed in the experiment were of analytical quality.

PROCUREMENT OF PLANT:

The leaves of *Streblus Asper* Lour. were sourced from Bardhaman district, West Bengal, due to the region's favorable climatic conditions, which are known to support the optimal biosynthesis of phytochemicals. The selection of this specific geographical location was based on the presence of the desired bioactive compounds, ensuring the authenticity and efficacy of the plant material for subsequent phytochemical and pharmacological investigations.

AUTHENTICATION OF THE PLANT:

The plant specimen was authenticated at Maharashtra College of Science, Arts, and Commerce, located at 246-A, Jahangir Boman Behram Marg, Nagpada, Mumbai, Maharashtra 400008. The authentication process confirmed the botanical identity of *Streblus asper* Lour., ensuring the accuracy and reliability of the plant material for further research and analysis.

SELECTION OF METHOD OF EXTRACTION:

Maceration was chosen as the extraction technique because it effectively extracts a variety of phytochemicals while preserving their structural integrity. By soaking the plant material in an appropriate solvent for a long time, this method promotes the slow diffusion of bioactive chemicals. In addition to avoiding prolonged heating, which might destroy thermolabile ingredients, it is a simple, cost-effective process that doesn't require complex equipment. Maceration is especially well-suited

for large-scale applications and offers superior solvent penetration when compared to Soxhlet extraction.

Because of its ability to dissolve both polar and non-polar components, ethanol was selected as the extraction solvent. Its safety, effectiveness, and environmental friendliness are the main reasons for its extensive usage in herbal extraction. Major bioactive groups like alkaloids, flavonoids, tannins, and polyphenols can be effectively extracted by ethanol, and these substances all play a key role in *Streblus asper* Lour's pharmacological potential. Moreover, it is the perfect solvent for therapeutic research due to its low toxicity and capacity to increase permeability. The excellent yield and stability of the phytochemicals are guaranteed by this solvent selection and extraction method.

Extraction Procedure

- The collected leaves were coarsely powdered.
- A plant-to-solvent ratio of 1:10 was adopted based on literature findings.
- 50 grams of the powdered leaf material was accurately weighed and placed into a 500 mL airtight iodometric flask.
- 500 mL of 99.5% ethanol was added to the flask.
- The mixture was stirred thoroughly and left to macerate for 48 hours with occasional agitation.
- Post maceration, the mixture was filtered using Whatman filter paper.
- The filtrate was then concentrated using a rotary evaporator to obtain the crude extract.
- This procedure was repeated until a sufficient amount of extract was collected.
- A total of 12.6 grams of ethanolic extract was ultimately obtained.

Phytochemical Analysis

Preliminary phytochemical screening was performed on the ethanolic extract of *Streblus asper* Lour. to identify the presence of key bioactive constituents.

Table 1: phytochemical tests

Sr. No.	Phytochemical Constituents	Test Name(s)
1	Alkaloids	Hager's Test, Dragendorff's Test
2	Flavonoids	NaOH Test, FeCl ₃ Test, Lead Acetate Test
3	Phenols & Tannins	Ferric Chloride Test, Lead Acetate Test
4	Amino Acids	Ninhydrin Test
5	Saponins	Foam Test
6	Steroids & Triterpenes	Salkowski's Test

TLC:-

Principle: A quick and simple technique, thin layer chromatography (TLC) is mostly used for qualitative evaluation of chemical substances. Adsorption chromatography is the basis for this technique, which separates components in a mixture based on their varying affinities for a mobile phase (a solvent or solvent mixture) and a stationary phase (often silica gel or alumina). A small amount of the material is put onto a TLC plate, which is subsequently put in a solvent-filled development chamber. Through capillary action, the solvent moves up the plate, carrying the components of the sample at different speeds according to their solubility and polarity. This causes them to separate, and a retention factor (R_f) shows how much each molecule moves relative to the others. TLC is a useful technique for quick phytochemical screening and reaction tracking

since the separated spots can be identified with the use of UV light or particular chemical reagents

Materials: Silica gel aluminum TLC plates (Merck Silica gel 60 F₂₅₄), Beaker (100 mL), UV light source (254 nm), Iodine chamber for visualization

Solvent: Ethanol

Sample Preparation: The sample was prepared by refluxing the flower powder in 25 ml ethanol for 2 hours. Filtered using Whatman 101 filter paper. Repeated extraction till no more color was released. Concentrated under vacuum. Final volume adjusted to 25 ml using ethanol.

Standard Used: Rutin, Quercetin, Gallic acid, lupeol, Stigmasterol.

Calculation: $R_f = \text{Distance travelled by the solute} / \text{Distance travelled by Solvent}$

Solvent System Used:**Table 2: List of solvent systems**

Compound Group	Solvent System Composition (v/v/v)
Rutin & Quercetin	Toluene: Ethyl Acetate: Methanol: Formic Acid: 4: 3: 2: 0.5 (v/v/v/v)
Lupeol	Toluene: ethylacetate : formic acid 7:2:1 (v/v/v)
Stigmasterol	Hexane : Acetone 4:1 (v/v)
Gallic Acid	Toluene : ethyl acetate 4:1 (v/v)

ANTIOXIDANT TESTING ASSAYS:**DPPH ANTIOXIDANT ASSAY:**

The approach is taken and somewhat altered. With DPPH, the extracts' ability to scavenge free radicals was assessed. In 99.50% ethanol, a DPPH solution (0.004% w/v) was made. To create the stock solution, 99.5% ethanol was combined with *Streblus asper* Lour ethanol extract (1 mg/mL). A freshly made DPPH solution (0.004% w/v) was placed in test tubes, and *Streblus asper* Lour extracts were added. Each test tube was then serially diluted (100–600 µg) until the final volume was 3 mL. After 30 minutes, a spectrophotometer (SHIMADZU UV-1900i) was used to measure the absorbance at 517 nm. As a reference standard, ascorbic acid was dissolved in distilled water to create a stock solution with the same concentration (1 mg/mL). Control sample was prepared containing the same volume without any extract and reference ascorbic acid. 99.50% Ethanol was used as blank. % scavenging of the DPPH free radical was measured using the following equation: Absorbance of the control minus absorbance of the test sample divided by absorbance of the control multiplied by 100. The inhibition curve was plotted for duplicate experiments and represented as % of mean inhibition ± standard deviation. IC₅₀ values were obtained by probit analysis. Calculated % scavenging activity using following equation:

% of DPPH radical Scavenging activity = $[(A_0 - A_1) / A_0] \times 100$ Where, A₀ is the absorbance of the control, and

A₁ is the absorbance of the Extract/standard¹²⁻¹⁴.

H₂O₂ RADICAL SCAVENGING ANTIOXIDANT ASSAY:

Following the guidelines provided in the Indian Pharmacopoeia (1996), a 0.2 M solution of potassium dihydrogen phosphate and a 0.2 M solution of sodium hydroxide were made. 50 ml of the potassium dihydrogen phosphate solution and 39.1 ml of the sodium hydroxide solution were added to a 200 ml volumetric flask to create a phosphate buffer with a pH of 7.4. Distilled water was used to bring the final volume down to 200 ml.

To create free radicals, an equivalent volume (50 ml) of this phosphate buffer was subsequently combined with hydrogen peroxide. To allow the reaction to finish, the mixture was allowed to sit at room temperature for five minutes.

0.6 ml of the hydrogen peroxide solution was mixed with 1 ml of the extract (dissolved in ethanol) to measure the antioxidant activity. A spectrophotometer (SHIMADZU UV-1900i) was used to detect the absorbance at 230 nm, using a blank solution—phosphate buffer devoid of hydrogen peroxide—as the reference.

The hydrogen peroxide scavenging activity of the extract was calculated using the following formula:

$$\% \text{ Scavenging of } H_2O_2 = [(A_0 - A_1) / A_0] \times 100$$

Where A_0 represents the absorbance of the control, and A_1 is the absorbance in the presence of the extract or standard.^{12,15-17}

REDUCING POWER ASSAY:

The approach was used to determine *Streblus asper* Lour's reduction power. In 1 milliliter of distilled water, several quantities of *Streblus asper* Lour extract (100–600 μ g) were combined with potassium ferricyanide [$K_3Fe(CN)_6$] (2.5 milliliters, 1%), and phosphate buffer (2.5 milliliters, 0.2 M, pH 6.6). For 20 minutes, the mixture was incubated at 50°C. After adding a quantity (2.5 mL) of 10% trichloroacetic acid, the mixture was centrifuged for 10 minutes at 3,000 rpm. The absorbance was measured at 700 nm using spectrophotometer (SHIMADZU UV-1900i) after the top layer of the solution (2.5 mL) was combined with 2.5 mL of distilled water and 0.5 mL of ferric chloride (0.1%). A higher reducing power was demonstrated by the reaction mixture's increased absorbance. As a reference standard, ascorbic acid was employed. The blank solution was phosphate buffer (pH 6.6)^{17,18}.

GC-MS ANALYSIS OF THE ETHANOLIC EXTRACT OF *STREBLUS ASPER* LOUR:

A comprehensive Gas Chromatography-Mass Spectrometry (GC-MS) analysis was carried out using HP5 column on the ethanolic extract of *Streblus asper* Lour. with the objective of identifying and quantifying the volatile phytochemical constituents present in the extract. This analytical procedure was conducted at Padmaja Aerobiologicals Pvt. Ltd., a recognized facility specializing in advanced phytochemical and microbiological testing, located at Plot No. 36, 'Nandan', near Bank of India Road, Sector 24, Turbhe, Navi Mumbai, Maharashtra – 400705.

The GC-MS profiling facilitated the detection, identification, and relative percentage estimation of various volatile compounds within the extract.

The data obtained from this GC-MS analysis provide a chemical basis for the bioactivity of the extract, justifying further investigation into its therapeutic mechanisms. These findings highlight the importance of volatile phytochemicals as key contributors to the neuropharmacological potential of *Streblus asper*, particularly in the context of epilepsy and related neurological conditions¹⁹⁻²¹.

PROCUREMENT OF EXPERIMENTAL LABORATORY ANIMALS:

The planning and preparatory phase of this in vivo experimental study involved the deliberate and scientifically justified selection of a suitable animal model. Swiss albino mice (*Mus musculus*) were chosen as the species and strain due to their well-characterized physiology, genetic uniformity, and extensive historical use in toxicological and pharmacological research. This selection aligns with the objectives of the study and supports the generation of reproducible and translatable results. Furthermore, an a priori power analysis was performed to determine the minimum sample size necessary to ensure statistical significance, while

simultaneously adhering to the principles of the 3Rs (Replacement, Reduction, and Refinement) to promote ethical use of animals in scientific research.

The experimental animals were procured from an accredited and licensed breeder, specifically the National Institute of Biosciences, located at GAT NO -69, At: Dhangawadi, Nigadewada Road, Off Pune-Bangalore Highway, Tal: Bhor, Dist: Pune – 412205, Maharashtra, India. The facility is registered under appropriate regulatory authorities and adheres to stringent standards for animal breeding, care, and transportation.

Upon arrival at the laboratory animal facility, the mice were immediately transferred to a designated quarantine area, where they were housed under controlled environmental conditions for a duration of 14 days, in accordance with standard operating procedures and institutional biosafety protocols. During this quarantine period, the animals were carefully monitored for signs of infectious diseases, stress, or physiological abnormalities, thereby ensuring only healthy animals proceeded to the experimental phase. Following the quarantine period, the mice were systematically grouped and individually marked using non-toxic permanent markers or ear tagging techniques to facilitate accurate identification and traceability throughout the study.

Subsequent to quarantine, the animals underwent an acclimatization period of 7 days within the designated experimental housing area. This period included routine handling by technical personnel to reduce stress responses and allow the animals to physiologically adapt to the experimental environment, including cage conditions, ambient noise levels, and personnel interactions. Standard housing conditions were maintained during acclimatization, with a temperature of 22–26°C, relative humidity of 45–65%, and a 12:12 light-dark cycle, as per CPCSEA and OECD guidelines. During this time, animals had free access to autoclaved standard rodent feed and filtered drinking water, ensuring a stable baseline physiological state prior to the initiation of experimental procedures.

ACUTE ORAL TOXICITY:

Healthy adult male Swiss albino mice, each with a body weight ranging from 27 to 30 grams, were selected for the acute toxicity study. The animals were randomly divided into experimental groups and housed in standard polycarbonate cages, with three animals per cage, under controlled laboratory conditions. Environmental parameters were maintained within recommended limits, with an ambient temperature of 25±2°C, relative humidity of 50–60%, and a controlled 14-hour light / 10-hour dark cycle. The mice were subjected to a 7-day acclimatization period prior to dosing, during which they were provided unrestricted access to a nutritionally balanced standard pellet diet and filtered drinking water ad libitum to ensure physiological stabilization.

All animal-handling protocols and experimental procedures were conducted in strict accordance with institutional guidelines and were reviewed and approved by the Institutional Animal Ethics Committee (IAEC) of Mumbai University, in compliance with CPCSEA

(Committee for the Purpose of Control and Supervision of Experiments on Animals) norms.

The acute oral toxicity assessment of the ethanolic extract of *Streblus asper* Lour. was carried out as per the internationally recognized OECD Guideline No. 423 (Acute Toxic Class Method). A single oral dose of the test extract, at a limit dose of **2000 mg/kg** body weight, was administered via oral gavage to the respective test groups using a calibrated gastric feeding needle. Following administration, animals were observed individually

during the first 30 minutes, periodically during the first 24 hours, and thereafter daily for a total of 14 days to monitor any signs of toxicity or behavioral changes.

Clinical observations included monitoring for signs such as piloerection, tremors, convulsions, salivation, lethargy, changes in locomotor activity, and respiratory patterns, along with regular checks for mortality and morbidity. Body weights were recorded at baseline (day 0), day 7, and day 14 to assess any significant changes over the study period²².

Table 3: grouping of animals for acute oral toxicity

Sr. No	Toxicity Group	Dose	Mice required per group
1.	Control Group	Saline	3
2.	<i>Streblus asper</i> Lour (Sheora) extract	50mg/Kg	3
3.		300mg/Kg	3
4.		2000mg/Kg	3
5.		5000mg/kg	3
Total Animals required			15

DOSE SELECTION AND CALCULATION:

The determination of dosing regimens for both the standard reference drugs and the ethanolic extract of *Streblus asper* Lour. was undertaken with a methodologically rigorous approach grounded in scientific literature, pharmacological databases, and toxicological safety assessments.

For the standard drugs used across both experimental models, doses were meticulously selected based on previously validated experimental studies, published in peer-reviewed journals, and in accordance with established pharmacopoeial guidelines. These doses were chosen to reflect optimal therapeutic efficacy in murine models while ensuring relevance to the intended pharmacological endpoints. The selection process included cross-referencing of multiple data sources to confirm species-specific sensitivity, bioavailability, and dose-response relationships in Swiss albino mice.

With regard to the ethanolic extract of *Streblus asper* Lour., the dose selection was underpinned by data obtained from a prior acute oral toxicity assessment conducted in strict compliance with OECD Test Guideline No. 423 (Acute Toxic Class Method). This study confirmed the absence of mortality or significant adverse effects at a limit dose of 2000 mg/kg body weight, thereby establishing a high safety threshold for the extract. Subsequently, an effective sub-toxic dose for pharmacological evaluation was extrapolated using both toxicological margin of safety and dose-response predictions derived from prior ethnopharmacological and experimental studies involving *Streblus asper* and other medicinal plant extracts with comparable phytoconstituent profiles.

This dual-reference methodology—drawing upon both toxicological data and literature-based pharmacological precedent—ensured that the selected dose of the ethanolic extract fell within a therapeutically meaningful, non-lethal range, appropriate for neuropharmacological investigations without eliciting systemic toxicity. The calculated dose was further refined to accommodate factors such as animal weight, route of administration, frequency of dosing, and experimental duration, ensuring maximum consistency, reproducibility, and compliance with ethical guidelines for animal experimentation.

The following doses were employed:

Ethanolic extract of *Streblus asper* Lour.:

High dose: 400 mg/kg body weight, administered orally. This dose was selected as a pharmacologically active sub-toxic dose, derived from the results of prior acute oral toxicity testing (OECD 423) and corroborated by literature on similar phytochemical-rich plant extracts.

Low dose: 200 mg/kg body weight, administered orally. This dose was chosen to assess dose-dependent effects, allowing comparison with the high dose to evaluate the extract's therapeutic window and efficacy in seizure suppression.

All doses were adjusted according to the body weight of the animals, and the route and timing of administration were optimized to match the pharmacokinetic and pharmacodynamic properties of each compound. This dosing protocol was designed to allow robust comparison between standard treatments and the test extract, as well as to elucidate the potential antiepileptic mechanisms of action of the plant-derived compounds.

DOSE OF DRUGS USED FOR INDUCTION OF DISEASE AND STANDARD DRUGS USED FOR TREATMENT :

Phenytoin (standard antiepileptic drug): 2 mg/kg body weight, administered intraperitoneally. This dose was selected based on its well-documented efficacy in tonic-clonic seizure models and is widely used in experimental settings involving electrically or chemically induced seizures.

Diazepam (benzodiazepine-class anticonvulsant): 30 mg/kg body weight, administered intraperitoneally. This dose was chosen based on its known GABAergic modulatory action, providing effective protection in PTZ-induced seizure models and is consistent with dosages reported in previous rodent studies.

Pentylenetetrazol (PTZ) (convulsant agent): 50 mg/kg body weight, administered intraperitoneally. This dose is commonly used to induce clonic convulsions in mice and serves as a reliable chemical model for evaluating the antiepileptic potential of test compounds.

MAXIMAL ELECTROSHOCK INDUCED CONVULSION MODEL:

Mice were divided into four groups (n = 6 per group): disease control, standard (phenytoin-treated), test group 1 (low-dose extract), and test group 2 (high-dose

extract). The test extract groups received their respective doses orally, 1 hour prior to seizure induction, while the standard group was administered phenytoin intraperitoneally 15 minutes before the experiment.

Tonic seizures were induced using an electroconvulsimeter delivering alternating current (35 mA, 0.2 s pulse duration, 50 Hz frequency) through saline-moistened ear clip electrodes to ensure proper electrical contact. The primary criterion for seizure induction was the tonic hind limb extension (HLE), characterized by a 180° extension of the hind limbs in alignment with the body axis.

During electroshock application, mice were observed for seizure activity. The following parameters were recorded for each animal:

- Latency to seizure onset
- Duration of tonic HLE
- Percentage protection against seizures (based on absence of HLE)
- Post-seizure mortality rate

Mice that did not exhibit tonic hind limb extension were considered protected, and protection was expressed as a percentage of animals in the group^{23,24}.

Table 4: MES induced convulsion grouping

Sr. no.	Group	Test Substance	Mice	Dose	Total
1	Normal Control	Dis. Water	6	1ml, P/O	6
2	Disease control	Dis. Water	6	1ml, P/O	6
3	Standard drug	phenytoin	6	2 mg/kg	6
4	Test Group-1	<i>Streblus asper</i> extract Dose 1	6	200mg/kg	6
5	Test Group-2	<i>Streblus asper</i> extract Dose 2	6	400mg/kg	6
Total					30

PENTYLENETETRAZOLE INDUCED CONVULSION MODEL:

To induce seizures, a single intraperitoneal injection of pentylenetetrazole (PTZ) at a dose of 50 mg/kg was administered to all experimental groups. Animals were divided into five groups (n = 6 per group): normal control, disease control (PTZ only), standard (diazepam-treated), test group 1 (low-dose extract), and test group 2 (high-dose extract).

The test extract groups received their respective doses orally 1 hour prior to PTZ administration. The standard group was treated with diazepam (4 mg/kg, orally) 30 minutes prior to PTZ injection. The control groups received appropriate volumes of vehicle.

Following PTZ administration, animals were observed continuously for a defined period to assess seizure activity. The following parameters were monitored and recorded:

Latency to seizure onset

Seizure stages or seizure severity score (using Racine scale 0-5)

Duration of seizures

Incidence of seizures

Mortality rate and percentage protection

Protection against seizures was evaluated based on the absence of convulsive episodes and mortality within the observation window²⁵⁻²⁹.

Table 5: pentylenetetrazole induced convulsion model

Sr.no	Group	Test Substance	Mice	Dose	Total
1	Normal Control	Dis. Water	6	1ml, P/O	6
2	Disease control	Dis. Water	6	1ml, P/O	6
3	Standard drug	diazepam	6	30 mg/kg	6
4	Test Group-1	<i>Streblus Asper</i> extract Dose 1	6	200 mg/kg	6
5	Test Group-2	<i>Streblus Asper</i> extract Dose 2	6	400 mg/kg	6
Total					30

BIOCHEMICAL TESTS:**PREPARATION OF BRAIN SAMPLE:**

Pentylenetetrazole (PTZ)-induced convulsions were used to test the anti-epileptic action, and mice from each experimental group were then humanely killed by cervical dislocation. To maintain tissue integrity, the brains were immediately removed and submerged in ice-cold saline. After weighing each brain, it was homogenized in 0.1 M phosphate buffer (pH 8.0). The resultant homogenates were divided into individual test tubes for biochemical examination, particularly to measure the amount of malondialdehyde (MDA), reduced glutathione (GSH), and catalase activity³⁰.

DETERMINATION OF CATALASE (CAT) ACTIVITY:

A cuvette containing 1.9 ml of 50 mM phosphate buffer (pH 7.0) was filled with 0.1 ml of the supernatant. The addition of 1.0 ml of newly made 30 mM hydrogen peroxide (H₂O₂) started the enzymatic reaction. Using spectrophotometry, the rate of H₂O₂ breakdown was tracked by measuring the absorbance drop at 240 nm. Units of catalase activity (U/100 µL) were computed and reported^{31,32}.

DETERMINATION OF MALONYLDIALDEHYDE (MDA):

A test tube was filled with an aliquot of the tissue homogenate suspension. This was followed by the addition of 0.5 ml of 8% thiobarbituric acid (TBA) reagent and 0.5 ml of trichloroacetic acid (TCA). Following an aluminum foil seal, the tubes were incubated for 30 minutes at 80°C in a water bath. Following incubation, the tubes were centrifuged for 15 minutes at 3000 rpm after being chilled for 30 minutes in cold water. Using a suitable blank, the absorbance of the resultant supernatant was measured at room temperature at 540 nm. Malondialdehyde (MDA) concentration was measured and reported as moles of MDA per milligram of protein (nmol MDA/mg protein)^{31,33,34}.

REDUCED GLUTATHIONE TEST (GSH):

Ellman's approach was used to estimate the amount of reduced glutathione (GSH) in mouse brain tissue. The brains were quickly removed, cleaned with ice-cold saline, and weighed after the ethical sacrifice. The tissue was centrifuged at 10,000 rpm for 15 minutes at 4°C after being homogenized at a 10% w/v ratio in 0.1 M phosphate buffer (pH 7.4). Analyses were conducted

using the resultant supernatant. 0.5 ml of the supernatant was combined with 0.5 ml of 5% ice-cold trichloroacetic acid (TCA) and centrifuged for 10 minutes at 3000 rpm in order to precipitate the proteins. The GSH assay was performed using the obtained clear supernatant. 2.0 ml of 0.1 M phosphate buffer (pH 8.0) and 0.5 ml of 0.01 M DTNB (5,5'-dithiobis-(2-nitrobenzoic acid)) reagent were added to 0.5 ml of this deproteinized supernatant. After 10 minutes of room temperature incubation, the absorbance at 412 nm was determined using spectrophotometry. A standard curve was used to calculate the GSH concentration, which was then represented as micromoles of GSH per milligram of protein³⁵.

STATISTICAL ANALYSIS:

GraphPad Prism software (Version 10.4.2), a popular tool for scientific charting, data organizing, and statistical analysis in biomedical research, was utilized to statistically evaluate the gathered data. The mean ± standard error of the mean (SEM), which gives a measure of the precision and variability of the mean value, was used to report the results for each experimental group or category.

A one-way analysis of variance (ANOVA) was performed to ascertain whether the experimental groups differed significantly from one another. When comparing the means of three or more independent groups, this statistical test is suited to determine whether there is a significant difference between at least one group and the others. Tukey's post-hoc test was used after the ANOVA revealed a statistically significant overall difference. This multiple comparison test reduces the likelihood of type I error (false positives) while pinpointing the precise groups that varied from one another.

For statistical significance, a p-value of less than or equal to 0.05 ($P \leq 0.05$) was used. The dependability of the results is supported by this threshold, which suggests that there is less than a 5% possibility that the observed changes happened by accident.

RESULTS:**% YIELD OF THE EXTRACT FROM THE LEAVES:**

After the extraction process was conducted for 100 gm of the dried and powdered leaves in ethanol the weight of the extract was found to be 12.6 gm. So by applying the formula

$$\text{Percent Yield} = (W2/W1) \times 100$$

W2 = weight of the extract obtained

Where,

W1 = weight of the dried & powdered *Streblus asper* leaves

$$\text{Percent yield} = (12.6/100) \times 100$$

So, the percent yield was found to be 12.6%

PHYTOCHEMICAL TESTS :

Table 6: Phytochemical tests

Sr. No.	Phytochemical Constituents	Name Of The Test	Ethanollic Extract
1.	Alkaloids	Hager's Test	+
		Dragndroff's Test	+
2.	Flavonoids	NaOH Test	++
		FeCl ₃ Test	+++
		Lead Acetate Test	+++
3.	Phenols And Tannins	Ferric Chloride	+++
		Lead Acetate Test	+++
4.	Amino Acids	Ninhydrin Test	-
5.	Saponins	Foam Test	-
6.	Steroids And Triterpenes	Salkowski's Test	++

+++ = High; ++ = Moderate; + = Present; - = Absent

5.1.3 TLC (THIN LAYER CHROMATOGRAPHY):

Table 7: TLC result

RF VALUE	COLOR	REMARK
0.75	Light yellow	Presence of Rutin confirmed
0.69	Yellow	Presence of quercetin confirmed
0.78	Purple	Presence of lupeol confirmed
0.55	violet	Presence of stigmasterol confirmed

GC-MS:

Among the compounds identified, phytol and β -caryophyllene were prominent. These constituents are well-documented in existing pharmacological literature for exhibiting anticonvulsant, neuroprotective, and anti-inflammatory activities, suggesting their potential role in the antiepileptic properties of the extract. The identification of such bioactive volatile oils supports the pharmacodynamic rationale for the traditional use of *Streblus asper* in the management of central nervous system disorders.

Abundance

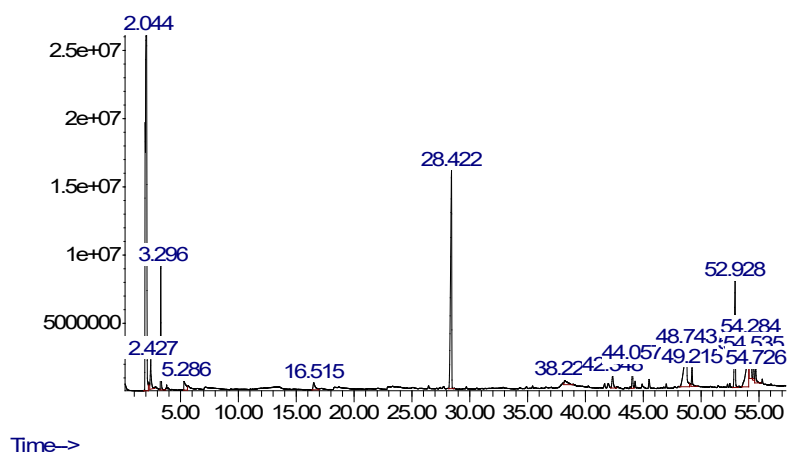


Figure 1: - GCMS

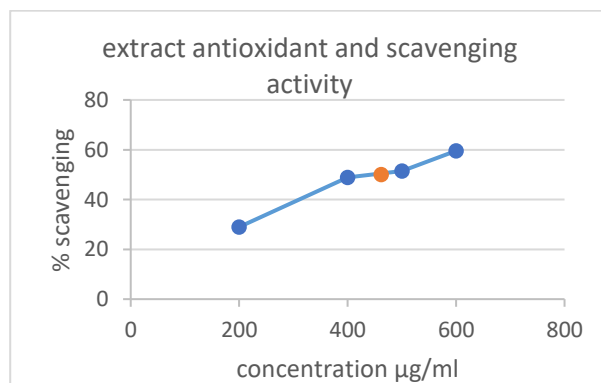
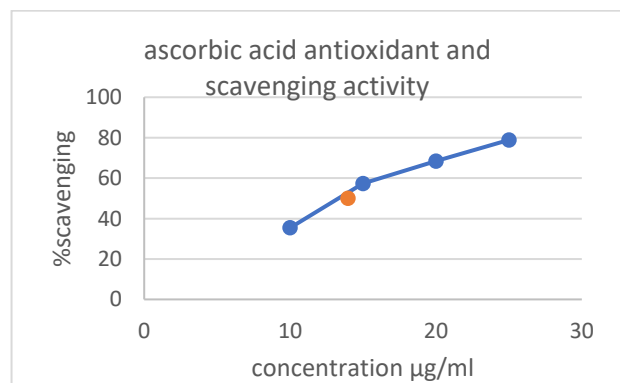
Table 8: GCMS analysis

Peak #	Ret Time	Area	Area %	Name of Component
1	2.044	250518934	39.865	Ethanol
2	2.427	11883465	1.891	2,3-Epoxybutane
3	3.296	28985950	4.612	Acetaldehyde, diethyl acetal
4	5.286	7992082	1.272	Dimethyl Sulfoxide
5	16.515	6840601	1.089	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-
6	28.422	112643229	17.925	Caryophyllene
7	38.221	6482861	1.032	.D-Melezitose
8	42.348	7653237	1.218	Geranyl isovalerate
9	44.057	8800975	1.400	Phytol, acetate
10	48.743	51188137	8.145	Isopropyl palmitate
11	49.215	7813908	1.243	Palmitic acid, ethyl ester
12	52.928	46322613	7.371	Phytol
13	54.063	38108411	6.064	cis,cis-Linoleic acid
14	54.284	26998879	4.296	α -Linolenic acid
15	54.535	9029144	1.437	Ethyl 9 α -linolenate
16	54.726	7161759	1.140	.Stearic acid
		628424185	100.000	

DPPH ANTIOXIDANT ASSAY:**Table 9: DPPH scavenging assay**

DPPH ANTIOXIDANT SCAVENGING ASSAY			
CONCENTRATION(μ G/ML)		ABSORBANCE	% SCAVENGING
200	STREBLUS ASPER EXTRACT	0.353	28.97384306
400		0.254	48.89336016
500		0.241	51.50905433
600		0.201	59.55734406
10	ASCORBIC ACID	0.321	35.41247485
15		0.212	57.34406439
20		0.157	68.41046278
25		0.105	78.87323944

Control absorbance – 0.497

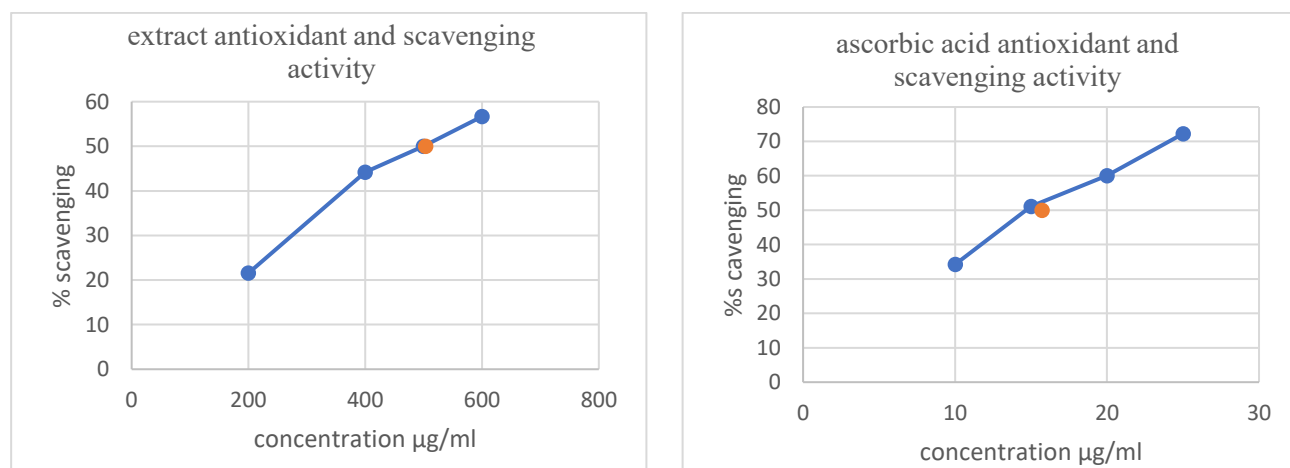
**Figure 2: DPPH scavenging antioxidant assay**

IC₅₀ value of herbal extract and ascorbic acid was found to be 461.938 μ g/ml and 13.96 μ g/ml from the graph.

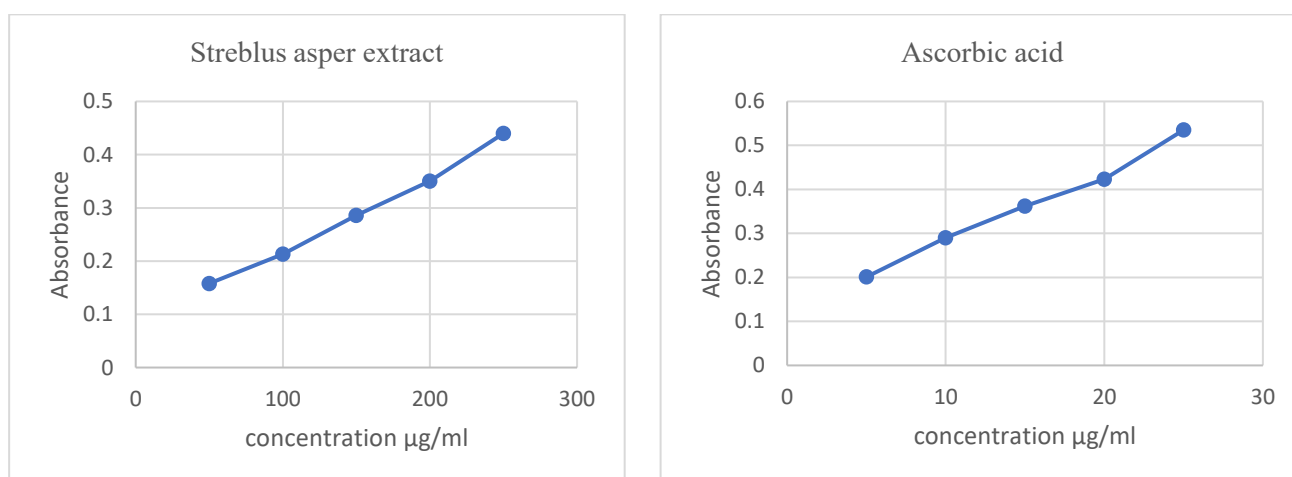
H2O2 SCAVENGING ASSAY :**Table 10: H2O2 scavenging assay**

H2O2 SCAVENGING ASSAY			
CONCENTRATION(μ G/ML)		ABSORBANCE	% SCAVENGING
200	STREBLUS ASPER EXTRACT	0.353	21.55555556
400		0.251	44.22222222
500		0.225	50
600		0.195	56.66666667
10	ASCORBIC ACID	0.296	34.22222222
15		0.22	51.11111111
20		0.18	60
25		0.125	72.22222222

Control absorbance – 0.45

**Figure 3: H2O2 scavenging antioxidant assay****FERRIC REDUCING POWER ANTIOXIDANT ASSAY:****Table 11: Ferric reducing power antioxidant assay**

PARAMETER	<i>STREBLUS ASPER EXTRACT</i>	STANDARD (ASCORBIC ACID)
Regression Equation	$y = 0.0008x + 0.1473$	$y = 0.016x + 0.1219$
R^2 Value	0.92	0.9908

**Figure 4: Ferric reducing power antioxidant assay**

ACUTE ORAL TOXICITY

No mortality or significant clinical signs of toxicity were observed in any of the treated animals throughout the 72-hour acute observation period and the 14-day follow-up

period. Based on these findings, the median lethal dose (LD_{50}) of the *Streblus asper* ethanolic extract was estimated to be greater than 2000 mg/kg, indicating that the extract exhibits low acute oral toxicity under the tested conditions.

MAXIMAL ELECTROSHOCK (MES) INDUCED CONVULSIONS METHOD:

Table 12: MES model result

GROUPS	TONIC FLEXION PHASE (S)	TONIC EXTENSOR PHASE (S)	CLONIC CONVULSION (S)	STUPOR (S)
diseased	4.6 ± 0.400	14.40 ± 0.509	22.40 ± 1.720	28.60 ± 2.379
standard	0.6 ± 0.246	2.00 ± 0.707	5.00 ± 1.049	7.80 ± 1.985
SA Extract (200mg/kg)	2.6 ± 0.254	7.80 ± 0.374	12.20 ± 0.734	16.20 ± 0.663
SA Extract (400mg/kg)	1.4 ± 0.255	5.60 ± 0.509	7.80 ± 0.374	12.40 ± 0.509

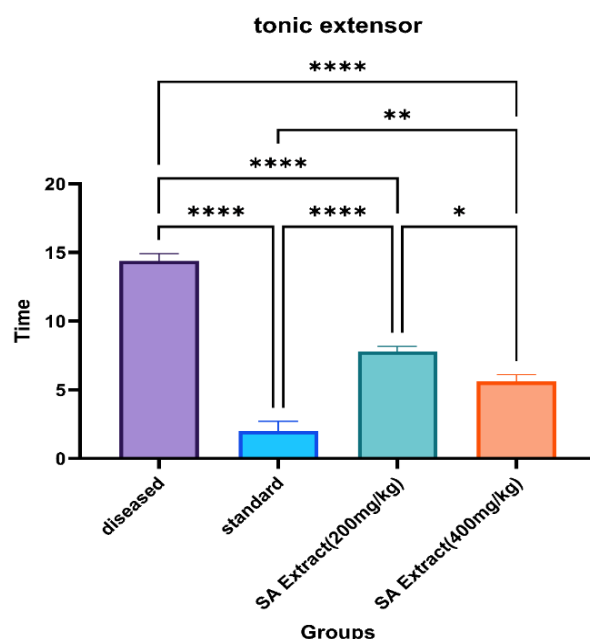


Figure 5: tonic extensor Phase in all groups

PTZ INDUCED CONVULSION MODEL:

Table 13: PTZ model result

GROUPS	ONSET OF JERK(SEC)	ONSET OF CLONUS (SEC)	DURATION OF CLONUS(SEC)
Diseased	60 ± 5.47	322 ± 25.77	5.8 ± 0.37
standard	70 ± 42.90	0 ± 0	0 ± 0
test 1 (200µgm/ml)	78 ± 8.0	394 ± 16.31	5.2 ± 0.37
test 2(400µgm/ml)	68 ± 28.0	534 ± 66.30	3.4 ± 0.50

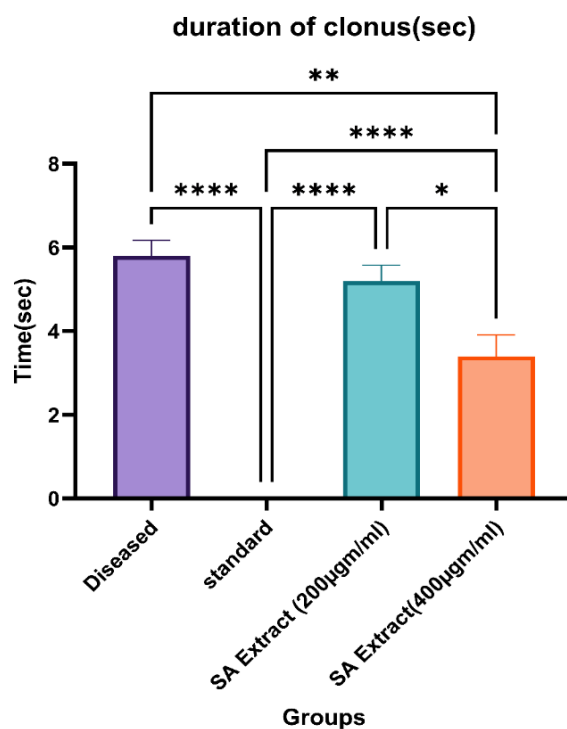


Figure 6: Duration of clonus in all groups in PTZ induced convulsion model

DETERMINATION OF CATALASE (CAT) ACTIVITY:

Table 14: CAT

GROUP	CAT ACTIVITY (U/100 µL)
Normal Control	0.004344±0.0001577
Diseased Control	0.01083±0.0001804
Standard Drug	0.008069±0.0004812
Test 1 (200 mg/kg)	0.01023±0.0002994
Test 2 (400 mg/kg)	0.009225±0.0001689

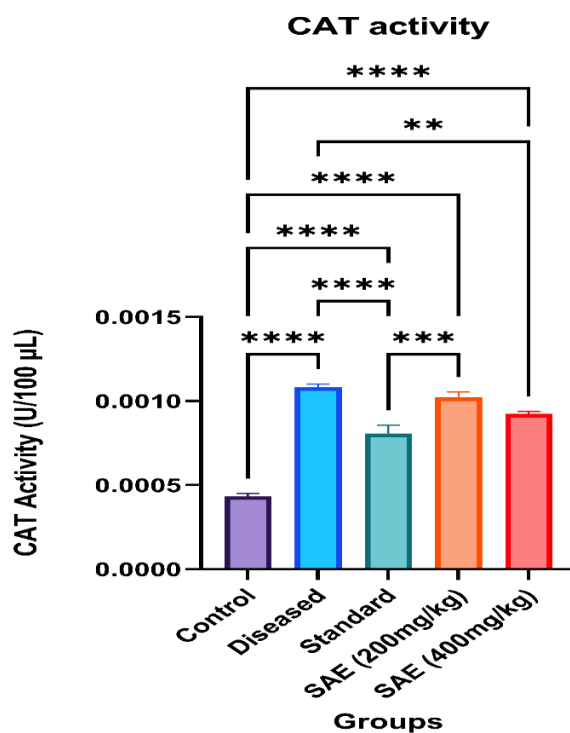
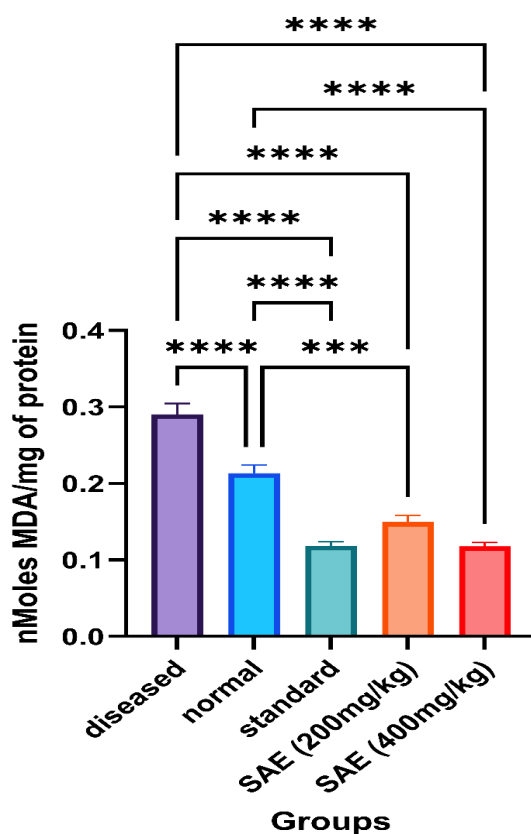


Figure 7: CAT

DETERMINATION OF MALONYLDIALDEHYDE (MDA):**Table 15: MDA**

GROUPS	MDA
Diseased	0.2906±0.01398
Normal	0.2137±0.01047
Standard	0.1186±0.005620
SAE (200mg/kg)	0.1496±0.008891
SAE (400mg/kg)	0.1177±0.005505

Malondialdehyde (MDA) assay**Figure 8: MDA****REDUCED GLUTATHIONE TEST (GSH):****Table 16: Reduced Glutathione Test**

Groups	GSH Concentrations (μ M)/mg protein
normal	41.11 $\pm$ 0.9872
diseased	20.8 $\pm$ 1.066
standard	37.27 $\pm$ 0.8395
SAE(200mg/kg)	37.27 $\pm$ 1.010
SAE(400mg/kg)	35.3 $\pm$ 0.9534

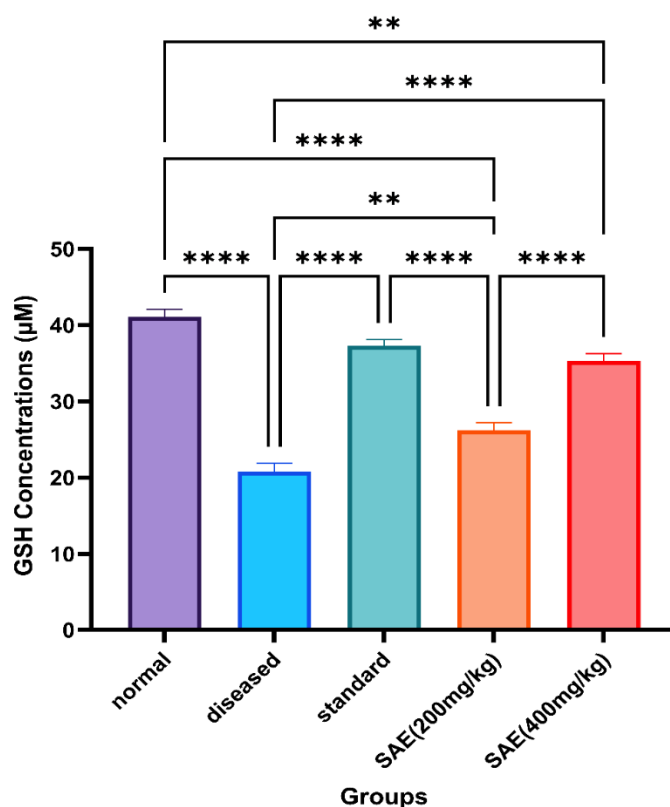


Figure 9: Reduced Glutathione Test

DISCUSSIONS:

PHYTOCHEMICAL TESTS:

The existence of important bioactive components as flavonoids, alkaloids, phenols, tannins, steroids, and triterpenes was validated by the phytochemical analysis of the ethanolic extract of *Streblus asper* Lour. The plant's antioxidant capacity, which is closely related to its neuroprotective and anti-epileptic properties, is supported by the presence of flavonoids and phenolic chemicals in particular. It is well recognized that these secondary metabolites improve GABAergic action, regulate oxidative stress, and maintain neuronal function.

THIN LAYER CHROMATOGRAPHY (TLC):

The ethanolic extract's recognized bioactive components, including lupeol, quercetin, and rutin, were verified by TLC analysis. The anti-inflammatory, antioxidant, and anticonvulsant qualities of these phytoconstituents have been documented in the literature. The obtained Rf values validated the extract's medicinal potential and showed good purity and component identification, since they were compatible with established markers.

DPPH ANTIOXIDANT ASSAY:

The DPPH assay measures the change in absorbance at 517 nm when the DPPH radical is neutralized in order to assess the antioxidants' capacity to scavenge free radicals. With an IC_{50} value of 461.938 µg/mL, *Streblus asper* demonstrated a concentration-dependent scavenging action. $IC_{50} = 333.22$ µg/mL for ascorbic acid, the standard, is slightly stronger than this, but it still

shows a moderate antioxidant capacity. These results provide credence to the existence of flavonoid and phenolic chemicals that enhance the plant's antioxidant potential.

H₂O₂ SCAVENGING ANTIOXIDANT ASSAY:

The extract shows strong free radical neutralization, with increasing scavenging action at higher doses, according to the hydrogen peroxide scavenging assay. Despite being marginally less effective than ascorbic acid, the extract's ability to neutralize peroxide and prevent oxidative damage supports its neuroprotective potential in seizure models with high ROS.

FERRIC REDUCING POWER ASSAY:

The extract's capacity to convert ferric (Fe^{3+}) to ferrous (Fe^{2+}) ions, which rose in a dose-dependent fashion, validated its reducing power. Moderate antioxidant strength was indicated by the EC_{50} value, which was marginally less than that of ascorbic acid. This characteristic reinforces its function in reducing neuronal damage brought on by oxidative stress, which is crucial in the pathophysiology of epilepsy.

ACUTE ORAL TOXICITY:

Mice given a limit dose of 2000 mg/kg of the extract over a 14-day period showed no mortality or clinical symptoms of toxicity. This suggests that *Streblus asper* is well tolerated at therapeutic dosages and has a broad safety margin. The study validates its usage in traditional medicine and supports its safe use in pharmacological trials.

MAXIMAL ELECTROSHOCK INDUCED CONVULSION METHOD (MES):

Similar to the common medication phenytoin, the ethanolic extract of *Streblus asper* demonstrated a significant decrease in tonic hind limb extension (THLE) duration in the MES model. This implies that the extract has potent anticonvulsant properties, most likely due to increased inhibitory neurotransmission or blockage of voltage-gated sodium channels. The extract may be useful in treating tonic-clonic seizures, as evidenced by the dose-dependent decrease in seizure parameters.

PENTYLENETETRAZOLE (PTZ) INDUCED CONVULSION:

The PTZ model antagonizes GABA-A receptors to simulate absence and myoclonic seizures. GABAergic activity was enhanced or excitatory-inhibitory balance was modulated, as evidenced by the extract's considerable delay in seizure start and reduction in clonus duration. *Streblus asper* may inhibit seizure propagation by modifying neurotransmission or oxidative stress processes, as evidenced by the protection seen in treated groups.

CATALASE (CAT) ACTIVITY:

Hydrogen peroxide (H₂O₂), a reactive oxygen species (ROS), is broken down by the essential antioxidant enzyme catalase into oxygen and water. Increased antioxidant defense is usually reflected in elevated catalase activity. Catalase activity significantly increased in PTZ-induced seizure mice in the study, indicating oxidative stress brought on by an excess of ROS. *Streblus asper* ethanolic extract treatment reduced this rise and brought catalase levels closer to the normal range, suggesting that it plays a part in reestablishing oxidative equilibrium and perhaps offering neuroprotection.

MALONDIALDEHYDE (MDA) ASSAY:

Lipid peroxidation produces MDA, which is a biomarker of oxidative stress. Increased membrane lipid damage, which is frequently caused by ROS in epileptic brain tissue, is reflected in elevated MDA levels. The PTZ-induced group in this study had elevated MDA levels, whereas *Streblus asper* therapy dramatically lowered MDA concentrations, indicating that the extract successfully shields neuronal membranes from oxidative damage.

REDUCED GLUTATHIONE (GSH) TEST:

A tripeptide called reduced glutathione serves as the key intracellular antioxidant by scavenging free radicals directly and preserving the redox equilibrium. Oxidative stress usually results in a decrease in GSH levels in epilepsy models. Oxidative damage was confirmed in this investigation by the considerable drop in GSH observed in the PTZ-treated group. Nonetheless, mice given *Streblus asper* extract exhibited a significant rise in GSH levels that was on par with the common medication diazepam, indicating the extract's strong antioxidant and neuroprotective properties.

CONCLUSION:

The ethanolic leaf extract of *Streblus Asper* has demonstrated significant anticonvulsant potential, which may be attributed to its multifaceted pharmacological properties. Primarily, the extract exhibits strong antioxidant activity, which plays a critical role in mitigating oxidative stress—a known contributor to the pathogenesis of epilepsy. By scavenging free radicals and enhancing endogenous antioxidant defense systems, the extract helps protect neuronal cells from oxidative damage that often accompanies seizure activity.

Moreover, the neuroprotective properties of *Streblus Asper* further contribute to its anticonvulsant effects. The extract has shown potential in preserving neuronal integrity and function, reducing neuronal apoptosis, and modulating neurotransmitter levels, particularly gamma-aminobutyric acid (GABA), which is pivotal in maintaining inhibitory control in the central nervous system. Through these mechanisms, it helps to stabilize neuronal excitability and prevent seizure propagation.

Phytochemical analysis of the ethanolic leaf extract reveals the presence of multiple bioactive compounds, including flavonoids, alkaloids, terpenoids, tannins, and phenolic compounds. Many of these constituents have well-established roles in modulating neurochemical pathways, reducing neuroinflammation, and exerting sedative or calming effects. Flavonoids, in particular, are known to enhance GABAergic neurotransmission and inhibit excitotoxicity, which may directly contribute to the observed anticonvulsant actions.

These pharmacological findings are further supported by in vivo experimental models, such as PTZ-induced seizure models in rodents, where the extract significantly delayed seizure onset, reduced seizure severity, and improved survival rates. Moreover results obtained after conducting biochemical tests like Catalase activity, Malondialdehyde test (MDA) and Reduced Glutathione test support the anti-epileptic activity. These results collectively suggest that *Streblus Asper* ethanolic leaf extract could serve as a natural, safe, and effective alternative or adjunct to conventional antiepileptic drugs, which often have limitations such as adverse side effects and drug resistance. Future studies focused on isolating active constituents, understanding precise mechanisms, and validating long-term safety could pave the way for its development into a clinically viable therapeutic option for epilepsy management.

Conflict of Interest: The authors declare no potential conflict of interest concerning the contents, authorship, and/or publication of this article.

Author Contributions: All authors have equal contributions in the preparation of the manuscript and compilation.

Source of Support: Nil

Funding: The authors declared that this study has received no financial support.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Ethical approval: Ethical approval was obtained from Ethics Committee of the Department of Pharmacology, Oriental College of Pharmacy, Navi Mumbai, Maharashtra

REFERENCES:

- Harris L, Angus-Leppan H. Epilepsy: diagnosis, classification and management. *Medicine (United Kingdom)*. 2020 Aug 1;48(8):522-8. <https://doi.org/10.1016/j.mpmed.2020.05.001>
- Stafstrom CE, Carmant L. Seizures and epilepsy: An overview for neuroscientists. *Cold Spring Harb Perspect Biol*. 2015;7(5):1-19. <https://doi.org/10.1101/cshperspect.a022426> PMID:26033084 PMCID:PMC4448698
- Pelito AL, Barker-Cummings C, Vasoli VM, Leibson CL, Hauser WA, Buchhalter JR, et al. Familial risk of epilepsy: A population-based study. *Brain*. 2014;137(3):795-805. <https://doi.org/10.1093/brain/awt368> PMID:24468822 PMCID:PMC3927702
- Kaculini CM, Tate-Looney AJ, Seifi A. The History of Epilepsy: From Ancient Mystery to Modern Misconception. *Cureus [Internet]*. 2021 Mar 17 [cited 2025 May 31];13(3). <https://doi.org/10.7759/cureus.13953> PMID:33880289 PMCID:PMC8051941
- Neligan A, Hauser WA, Sander JW. Epilepsy. *Handbook of Clinical Neurology*. Elsevier B.V.; 2012. 113-33 p. (Handbook of Clinical Neurology; vol. 107). <https://doi.org/10.1016/B978-0-444-52898-8.00006-9> PMID:22938966
- Streblus asper - Wikipedia [Internet]. [cited 2025 Mar 23]. Available from: https://en.wikipedia.org/wiki/Streblus_asper
- Mukherjee K, Roy LN. Chemical examination of streblus asper leaves. *Pharm Biol*. 1983;21(4):189-90. <https://doi.org/10.3109/13880208309070642>
- Pandey MM, Rastogi S. Streblus asper: A phytochemical, ethnopharmacological and pharmacological research update *Journal of Pharmacognosy and Phytochemistry* 2022; 11(3):07-18 <https://doi.org/10.22271/phyto.2022.v11.i3a.14402>
- Neekhara S, Awasthi H, Singh D. Potential Therapeutic use of Streblus asper: A Review. *International Journal of Research and Development in Pharmacy & Life Sciences*. 2017 Dec;6(7):2845-9. [https://doi.org/10.21276/IJRDP.2278-0238.2017.6\(7\).2845-2849](https://doi.org/10.21276/IJRDP.2278-0238.2017.6(7).2845-2849)
- Ren Y, Chen WL, Lantvit DD, Sass EJ, Shriwas P, Ninh TN, et al. Cardiac Glycoside Constituents of Streblus asper with Potential Antineoplastic Activity. *J Nat Prod*. 2017 Mar 24;80(3):648-58. <https://doi.org/10.1021/acs.jnatprod.6b00924> PMID:27983842 PMCID:PMC5365359
- Rastogi S, Kulshreshtha DK, Rawat AKS. Streblus asper Lour. (Shakhotaka): A review of its chemical, pharmacological and ethnomedicinal properties. *Evidence-based Complementary and Alternative Medicine*. 2006 Jun;3(2):217-22. <https://doi.org/10.1093/ecam/nel018> PMID:16786051 PMCID:PMC1475940
- Gulcin İ, Alwasel SH. DPPH Radical Scavenging Assay. *Processes* 2023, Vol 11, Page 2248 [Internet]. 2023 Jul 26 [cited 2025 Jun 9];11(8):2248. <https://doi.org/10.3390/pr11082248>
- DPPH Assay - an overview | ScienceDirect Topics. Available from: <https://www.sciencedirect.com/topics/food-science/dpph-assay>
- Baliyan S, Mukherjee R, Priyadarshini A, Vibhuti A, Gupta A, Pandey RP, et al. Determination of Antioxidants by DPPH Radical Scavenging Activity and Quantitative Phytochemical Analysis of Ficus religiosa. *Molecules [Internet]*. 2022 Feb 1 [cited 2025 Jun 9];27(4):1326. <https://doi.org/10.3390/molecules27041326> PMID:35209118 PMCID:PMC8878429
- My A, Yp A, Sk A. Phytochemical Screening and Evaluation of Antioxidant Activity of hydroalcoholic extract of Justicia procumbans leaf. *Journal of Ayurvedic and Herbal Medicine*. 2021;7(1):41-5. <https://doi.org/10.31254/jahm.2021.7109>
- (PDF) Hydrogen Peroxide Radical Scavenging and Total Antioxidant Activity of Hawthorn [Internet]. [cited 2025 Jun 9]. Available from: https://www.researchgate.net/publication/260343716_Hydrogen_Peroxide_Radical_Scavenging_and_Total_Antioxidant_Activity_of_Hawthorn
- Hussen EM, Endalew SA. In vitro antioxidant and free-radical scavenging activities of polar leaf extracts of Vernonia amygdalina. *BMC Complement Med Ther [Internet]*. 2023 Dec 1 [cited 2025 Jun 9];23(1):1-12. <https://doi.org/10.1186/s12906-023-03923-y> PMID:37143058 PMCID:PMC10157976
- Bhatti MZ, Ali A, Ahmad A, Saeed A, Malik SA. Antioxidant and phytochemical analysis of Ranunculus arvensis L. extracts. *BMC Res Notes*. 2015;8(1):1-8. <https://doi.org/10.1186/s13104-015-1228-3> PMID:26123646 PMCID:PMC4485861
- Thamer FH, Thamer N. Gas chromatography - Mass spectrometry (GC-MS) profiling reveals newly described bioactive compounds in Citrullus colocynthis (L.) seeds oil extracts. *Heliyon [Internet]*. 2023 Jun 1 [cited 2025 Jun 9];9(6):e16861. <https://doi.org/10.1016/j.heliyon.2023.e16861> PMID:37484228 PMCID:PMC10360964
- Gomathi D, Kalaiselvi M, Ravikumar G, Devaki K, Uma C. GC-MS analysis of bioactive compounds from the whole plant ethanolic extract of Evolvulus alsinoides (L.) L. *J Food Sci Technol*. 2013;52(2):1212. <https://doi.org/10.1007/s13197-013-1105-9> PMID:25694742 PMCID:PMC4325072
- PHYTOCHEMICAL SCREENING AND GC-MS ANALYSIS OF BIOACTIVE COMPOUNDS PRESENT IN ETHANOLIC EXTRACTS OF LEAF AND FRUIT OF TRICHOSANTHESIS DIOICA ROXB. | INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH [Internet]. [cited 2025 Jun 9]. Available from: <https://ijpsr.com/bft-article/phytochemical-screening-and-gc-ms-analysis-of-bioactive-compounds-present-in-ethanolic-extracts-of-leaf-and-fruit-of-trichosanthesis-dioica-roxb/>
- Oecd. OECD/OCDE 423 OECD GUIDELINE FOR TESTING OF CHEMICALS Acute Oral Toxicity-Acute Toxic Class Method INTRODUCTION. 2001.
- Sawicka KM, Wawryniuk A, Zwolak A, Daniluk J, Szpringer M, Florek-Luszczki M, et al. Influence of Ivabradine on the Anticonvulsant Action of Four Classical Antiepileptic Drugs Against Maximal Electroshock-Induced Seizures in Mice maximal electroshock-induced seizure model was pharma-codynamic in nature. *Neurochem Res*. 1234;42:1038-43. <https://doi.org/10.1007/s11064-016-2136-1> PMID:28083847 PMCID:PMC5375969
- Mombeini T, Asadpour Behzadi B, Ejtemaei R, Tahmasbi F, Kamalinejad M, Reza Dehpour A. Anti-convulsant Effect of Alcea aucheri on Pentylenetetrazole and Maximal Electroshock Seizures in Mice. *Basic and Clinical Neuro-science. Basic and Clinical [Internet]*. [cited 2025 Apr 16];11(3):369-78. <https://doi.org/10.32598/bcn.11.2.2064.1> PMID:32963729 PMCID:PMC7502187
- (PDF) " Evaluation Of Anti-Convulsant Activity Of Aqueous Extract Of Argyreia Nervosa Against Induce By Mes And Ptz Methods In Mice " [Internet]. [cited 2025 Jun 9]. Available from: https://www.researchgate.net/publication/313898987_Evaluation_Of_Anti-Convulsant_Activity_Of_Aqueous_Extract_Of_Argyreia_Nervosa_Against_Induce_By_Mes_And_Ptz_Methods_In_Mice
- Fisseha N, Shibeshi W, Bisrat D. Evaluation of Anticonvulsant Activity of 80% Methanolic Root Bark Extract and Solvent Fractions of Pentas schimperiana (A. Rich.) Vatke (Rubiaceae) in Swiss Albino Mice. *Adv Pharmacol Pharm Sci [Internet]*. 2021 Jan 1 [cited 2025 Jun 9];2021(1):6689879.

- <https://doi.org/10.1155/2021/6689879> PMid:34212153
PMCID:PMC8205597
27. Jain P, Tambe R, Sancheti J, Nahire M, Bhardwaj A, Sathaye S. Screening of Pistacia integerrima extracts for their anticonvulsant activity in acute zebrafish and rodent models of epilepsy. *Int J Nutr Pharmacol Neurol Dis* [Internet]. 2015 Apr 1 [cited 2025 Jun 9];5(2):56-62. <https://doi.org/10.4103/2231-0738.153793>
 28. Venkatesan PS, Sundaresan S, Eswarya M, Madhavaselvi M, Renuka R. Evaluation of antiepileptic properties of herbal mix of different combinations by PTZ-induced mouse model. *Phytomedicine Plus*. 2025;5(2):100773. <https://doi.org/10.1016/j.phyplu.2025.100773>
 29. Bhat JU, Nizami Q, Asiaf A, Parray SA, Ahmad ST, Aslam M, et al. Anticonvulsant activity of methanolic and aqueous extracts of *Melissa parviflora* in experimentally induced Swiss albino mice. *EXCLI J*. 2012;11:1. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC4897659/>
 30. Gueroui M, Kechrid Z. Evaluation of Some Biochemical Parameters and Brain Oxidative Stress in Experimental Rats Exposed Chronically to Silver Nitrate and the Protective Role of Vitamin E and Selenium. *Toxicol Res*. 2016;32(4):301. <https://doi.org/10.5487/TR.2016.32.4.301> PMid:27818732
PMCID:PMC5080859
 31. Mihajlović I, Maslovarić A, Mladenović A, Miljković T, Miljković N, Sokolović D. CATALASE ACTIVITY AND MALONDIALDEHYDE CONCENTRATION IN THE BRAIN TISSUE OF RATS TREATED WITH CARBON TETRACHLORIDE. *Acta Medica Medianae*. 2021 Dec 15;60(4):39-44. <https://doi.org/10.5633/amm.2021.0406>
 32. Catalase activity in brain tissue homogenates expressed in U/g f.t. in... | Download Scientific Diagram [Internet]. [cited 2025 Jun 9]. Available from: https://www.researchgate.net/figure/Catalase-activity-in-brain-tissue-homogenates-expressed-in-U-g-ft-in-three-time_fig1_350099140
 33. Malondialdehyde (MDA) level in mice kidney, testis, brain, liver,... | Download Scientific Diagram [Internet]. [cited 2025 Jun 10]. Available from: https://www.researchgate.net/figure/Malondialdehyde-MDA-level-in-mice-kidney-testis-brain-liver-heart-and-spleen_fig3_332940231
 34. Sani M, Ghanem-Boughanmi N, Gadacha W, Sebai H, Boughattas NA, Reinberg A, et al. Malondialdehyde content and circadian variations in brain, kidney, liver, and plasma of mice. *Chronobiol Int*. 2007;24(4):671-85. <https://doi.org/10.1080/07420520701535720> PMid:17701679
 35. Moron MS, Depierre JW, Mannervik B. Levels of glutathione, glutathione reductase and glutathione S-transferase activities in rat lung and liver. *Biochimica et Biophysica Acta (BBA) - General Subjects*. 1979;582(1):67-78. [https://doi.org/10.1016/0304-4165\(79\)90289-7](https://doi.org/10.1016/0304-4165(79)90289-7)