

HISTOPATHOLOGICAL EVIDENCE OF NEUROPROTECTION BY *CRASSULA OVATA* IN PTZ-INDUCED SEIZURE MODEL IN ALBINO RATS

Satheeshkumar N.*

SSM College of Pharmacy, Jambai, Erode Dt, Tamilnadu.

Article Received: 2 January 2026 | Article Revised: 23 January 2026 | Article Accepted: 12 February 2026

*Corresponding Author: Satheeshkumar N.
SSM College of Pharmacy, Jambai, Erode Dt, Tamilnadu.
DOI: <https://doi.org/10.5281/zenodo.18639680>

How to cite this Article: Satheeshkumar N. (2026) HISTOPATHOLOGICAL EVIDENCE OF NEUROPROTECTION BY *CRASSULA OVATA* /N PTZ-INDUCED SEIZURE MODEL IN ALBINO RATS. World Journal of Pharmaceutical Science and Research, 5(2), 582-591. <https://doi.org/10.5281/zenodo.18639680>



Copyright © 2026 Satheeshkumar N. | World Journal of Pharmaceutical Science and Research.

This work is licensed under creative Commons Attribution-NonCommercial 4.0 International license (CC BY-NC 4.0).

ABSTRACT

When seizures hit the brain over and over, you can actually see the fallout under a microscope—neurons die off, vacuoles pop up, gliosis takes over, and the neat layers of the cortex start falling apart. That’s a big deal for anyone studying epilepsy or neurodegenerative diseases. In this study, we wanted to find out if *Crassula ovata*, a plant with a long track record in traditional medicine, actually shields the brain from that kind of damage. We used an ethanol extract of *C. ovata* in a rat model, where seizures were triggered with PTZ. To check what was going on, we stained brain slices with haematoxylin and eosin, then took a close look under the microscope—switching between 4x, 10x, and 40x zoom. Rats that got PTZ alone showed obvious neurodegeneration, vacuolization, gliosis, and the breakdown of cortical layers. But when we gave them *C. ovata* (at 200 or 400 mg/kg), the damage dropped off sharply. The plant extract clearly helped protect brain tissue from seizure-induced injury. So, based on these histopathology results, *C. ovata* looks pretty promising as a neuroprotective, anti-epileptic agent.

KEYWORDS: *Crassula ovata*, PTZ-induced seizures, neuroprotection, H&E staining, histopathology.

INTRODUCTION

Epilepsy isn’t just about abnormal bursts of electrical activity in the brain. Over time, repeated seizures can actually damage brain tissue—killing neurons, triggering gliosis, messing up the cortex, and causing vacuoles to form, mostly because of excitotoxicity and oxidative stress. That’s why looking at brain tissue under a microscope is still one of the best ways to judge how much damage is happening and whether treatments are actually protecting the brain. Lately, a lot of attention has turned to medicinal plants packed with natural compounds that might help limit this kind of damage. Take *Crassula ovata*, for example. People have used this succulent in traditional medicine for ages, and it’s known for its antioxidant and neuroprotective effects. Researchers have started looking into its ability to prevent seizures, but hardly anyone has focused on whether it actually protects brain structure at the microscopic level. So, in this study,

we're zooming in on the brain to see if *Crassula ovata* extract really guards against the damage PTZ-induced seizures cause.

MATERIALS AND METHODS

Experimental Animals

For this study, we used healthy adult Albino Wistar rats, both male and female, weighing between 180 and 220 grams. They lived in standard lab conditions—room temperature around 22 degrees Celsius, humidity at 55 percent, and a 12-hour light and dark cycle. The rats could eat regular pellet food and drink water whenever they wanted. All experiments followed CPCSEA guidelines and had approval from the Institutional Animal Ethics Committee.

Induction of Seizures

We triggered seizures by injecting pentylenetetrazol (PTZ) into the rats' abdomen at 50 mg per kilogram of body weight. PTZ is a chemical that reliably causes generalized clonic seizures by blocking GABA-A receptors. This action ramps up nerve activity and can damage brain cells.

Treatment Protocol

We gave the rats an ethanolic extract of *Crassula ovata* by mouth once a day at two different doses: 200 mg/kg and 400 mg/kg. For comparison, we used phenytoin at 25 mg/kg as the standard drug.

Experimental Grouping

Group	Treatment	Dose	Route of Administration
G1	Normal Control	NA	Oral
G2	PTZ Control	50 mg/kg	Intraperitoneal
G3	PTZ + Phenytoin	25 mg/kg	Oral
G4	PTZ + <i>Crassula ovata</i> Extract	200 mg/kg	Oral
G5	PTZ + <i>Crassula ovata</i> Extract	400 mg/kg	Oral

Tissue Collection

At the end of the experiment, we humanely sacrificed the animals while they were under light anesthesia. Right after, we removed their brains, rinsed them with ice-cold saline to wash away any blood, and fixed them in 10% neutral buffered formalin for later histopathological analysis.

Histopathological Processing

We processed the fixed brain tissues using standard paraffin-embedding methods. Using a rotary microtome, we cut coronal sections about 5 micrometers thick and placed them onto clean glass slides.

Hematoxylin and Eosin (H&E) Staining

For staining, we used the Hematoxylin and Eosin (H&E) technique. The sections were first deparaffinized, then rehydrated through a series of graded alcohols. We stained them with hematoxylin to bring out the nuclei, followed by eosin to highlight the cytoplasm. After dehydration and clearing with xylene, we mounted the slides using DPX mounting medium.

Microscopic Evaluation

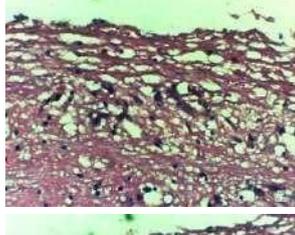
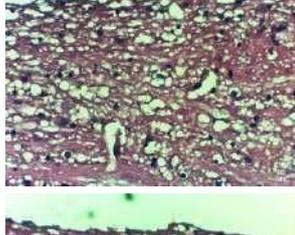
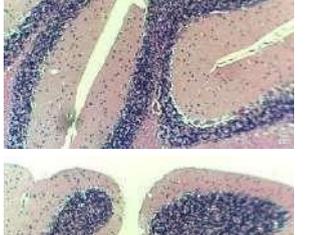
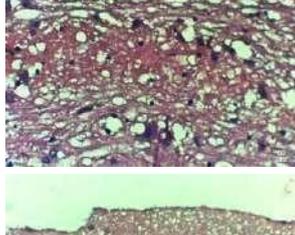
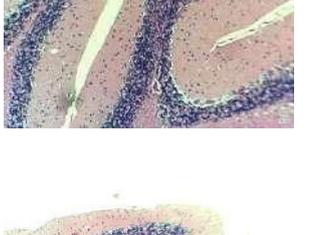
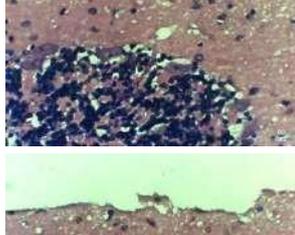
We examined the stained sections under a trinocular light microscope at 4×, 10×, and 40× magnifications. During evaluation, we looked closely at a few key things:

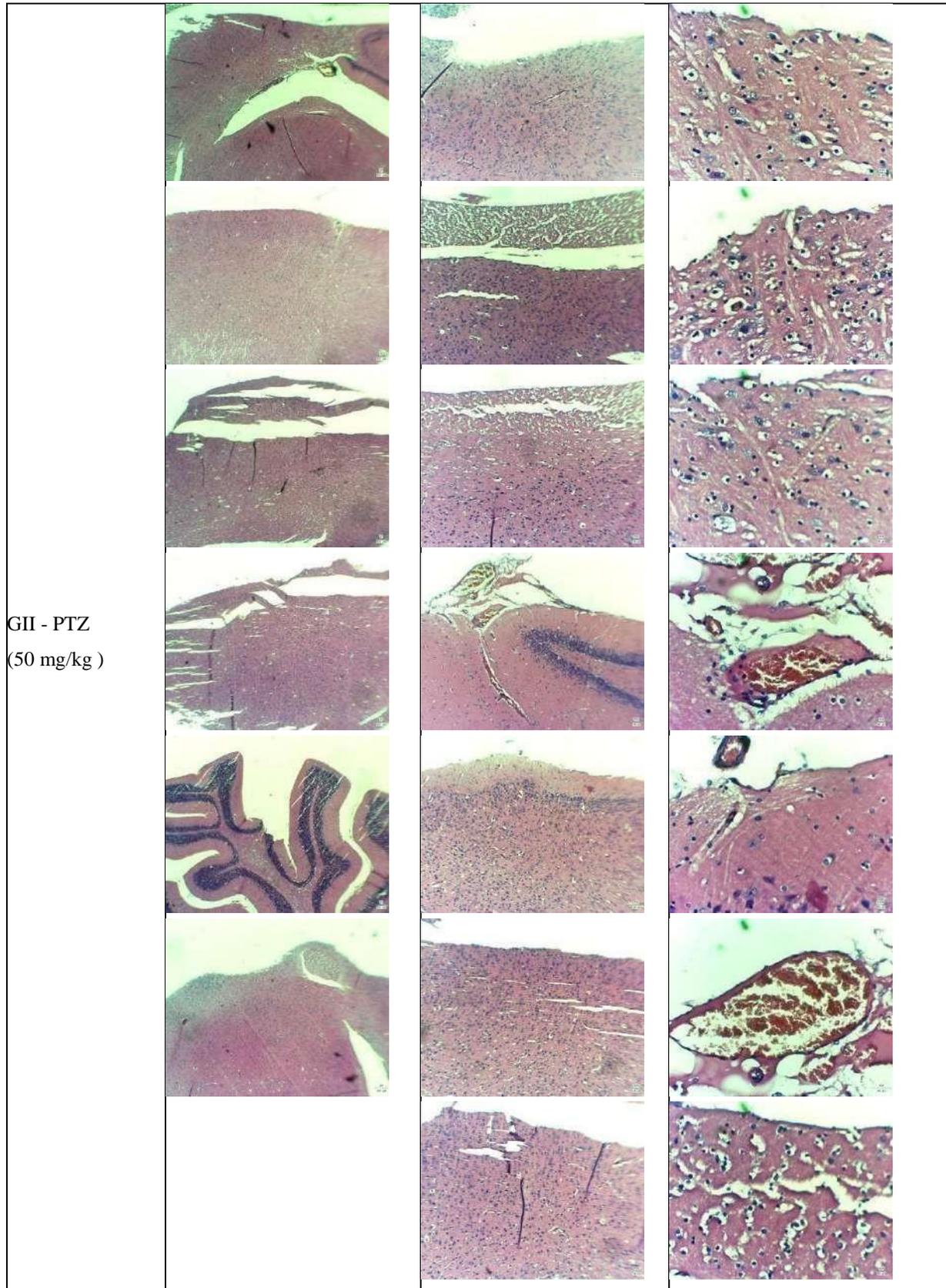
- Neuronal integrity and overall cell shape
- Signs of neuronal degeneration or necrosis
- Any cytoplasmic vacuolization
- Evidence of gliosis and inflammatory cell infiltration
- Changes in the structure of the cortex and hippocampus.

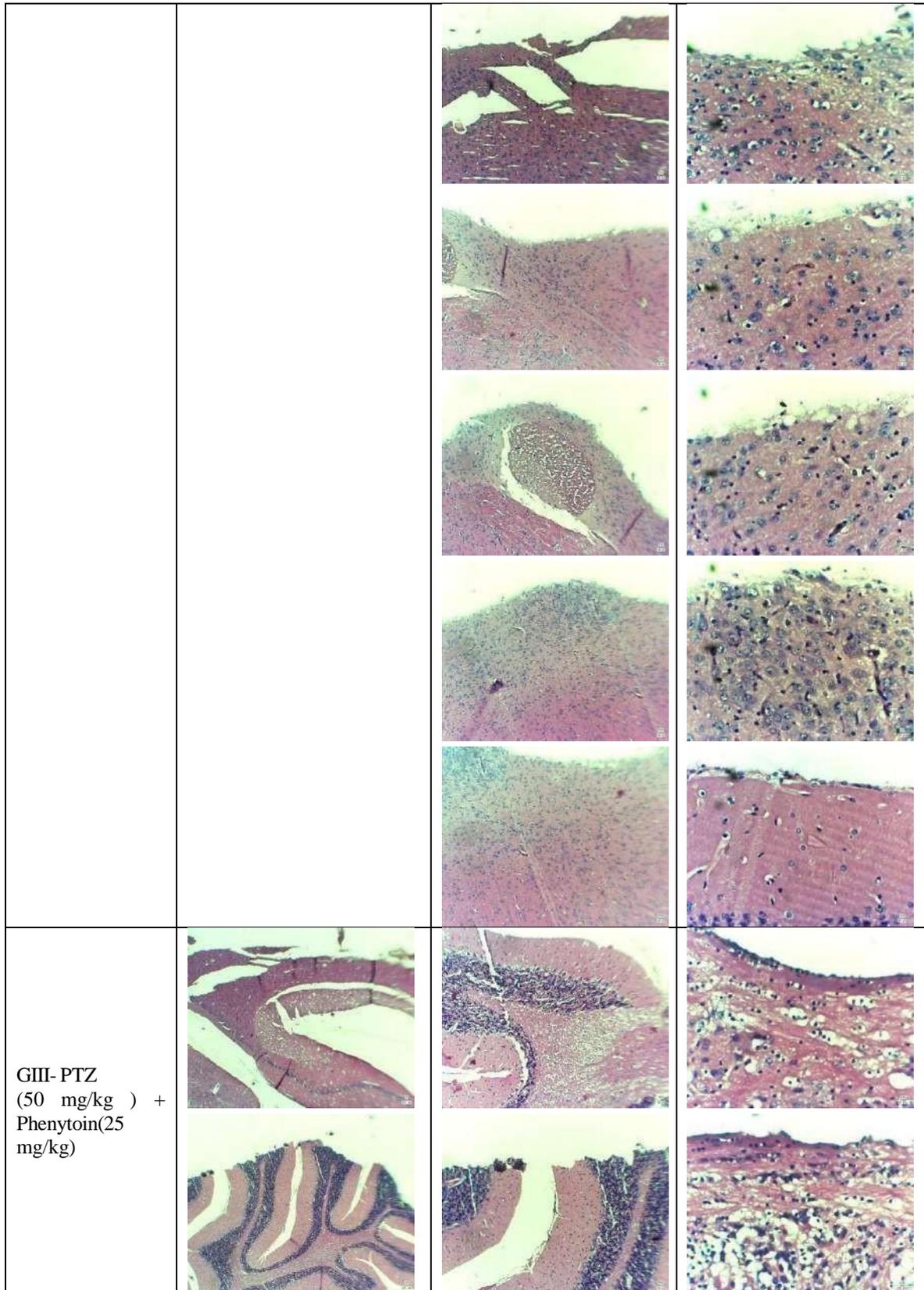
Histopathological Assessment Criteria

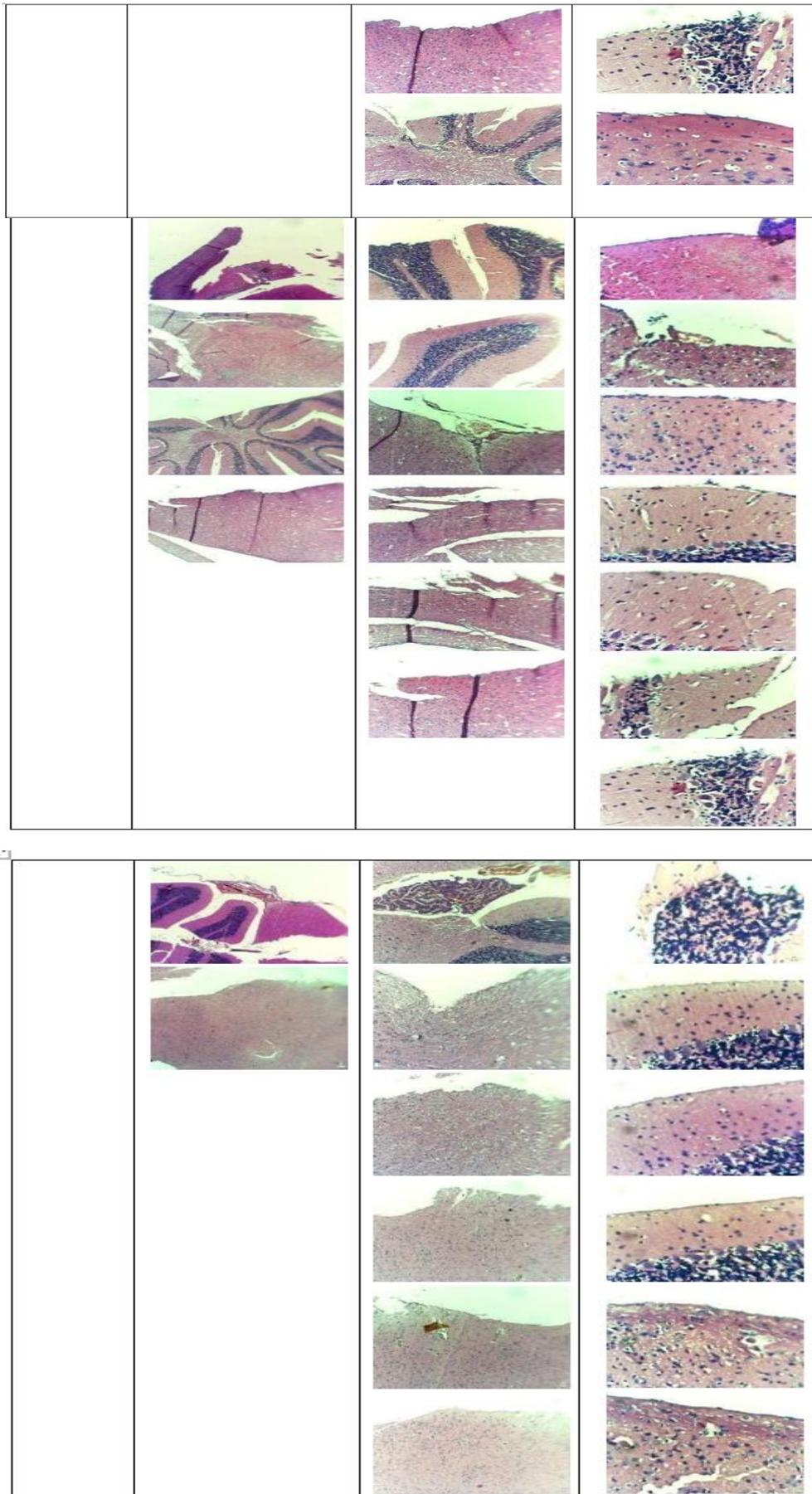
To check for neuroprotective effects, we compared each treated group to the PTZ control group. We looked for less neuronal damage, normal brain structure, and fewer signs of inflammation—these all point toward protective activity.

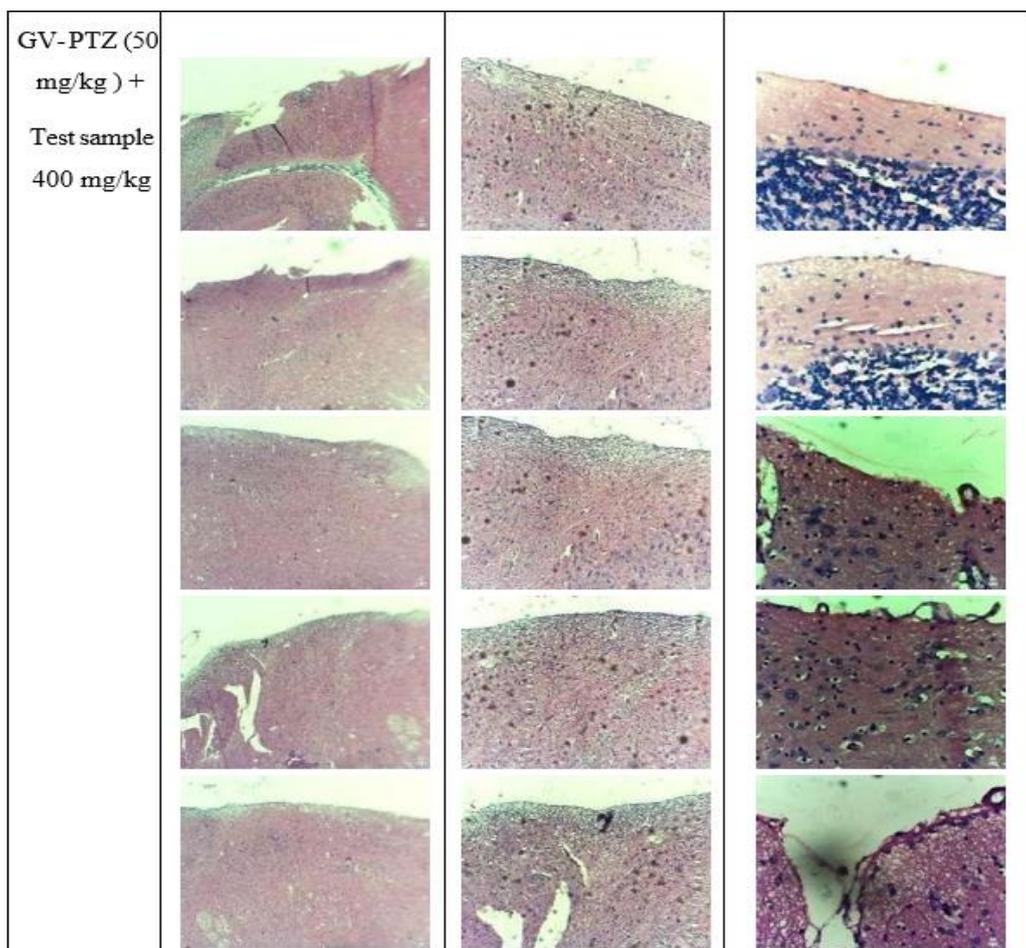
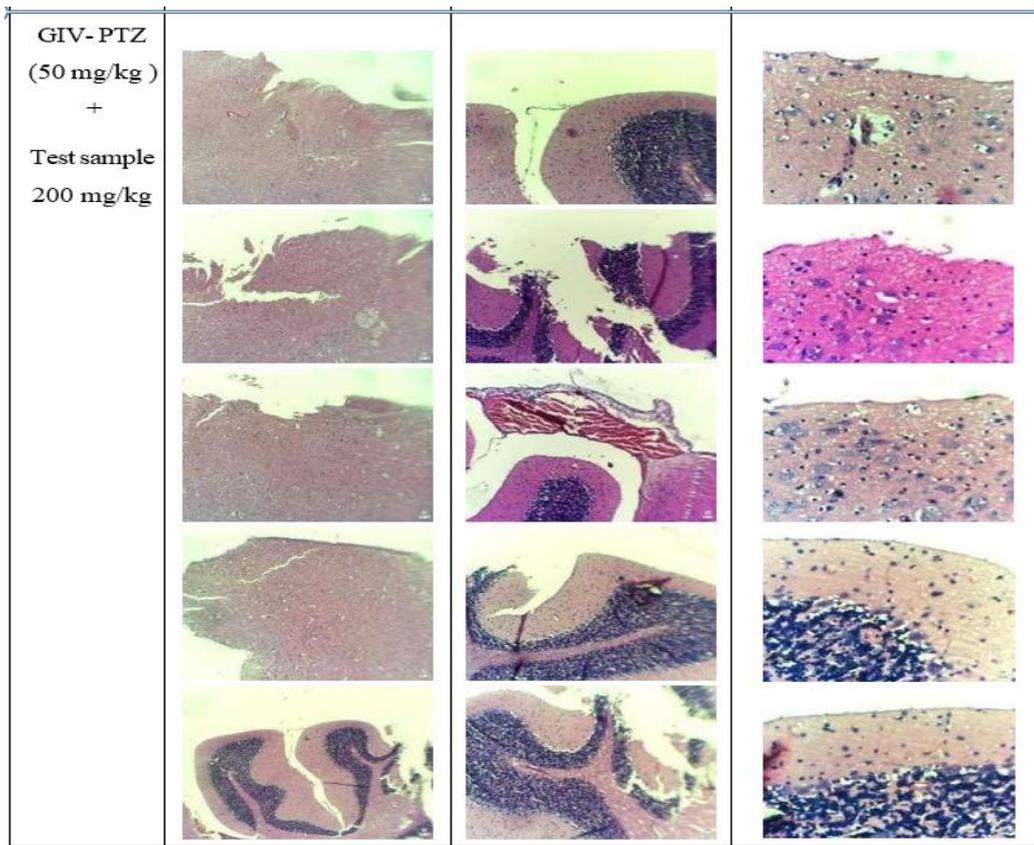
HISTOPATHOLOGICAL RESULTS

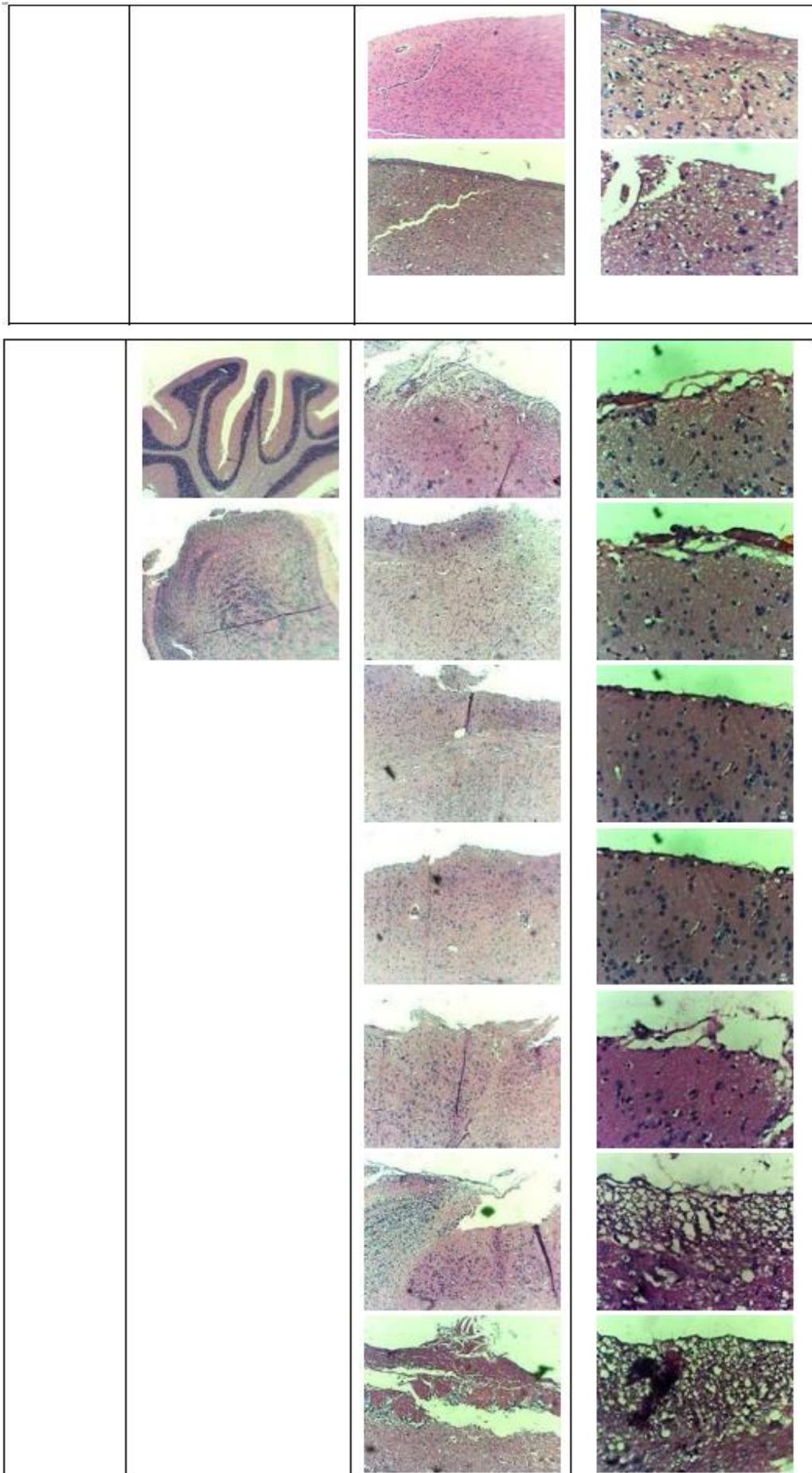
Groups	4x	10x	40x
GI - Control			
			
			
			
			











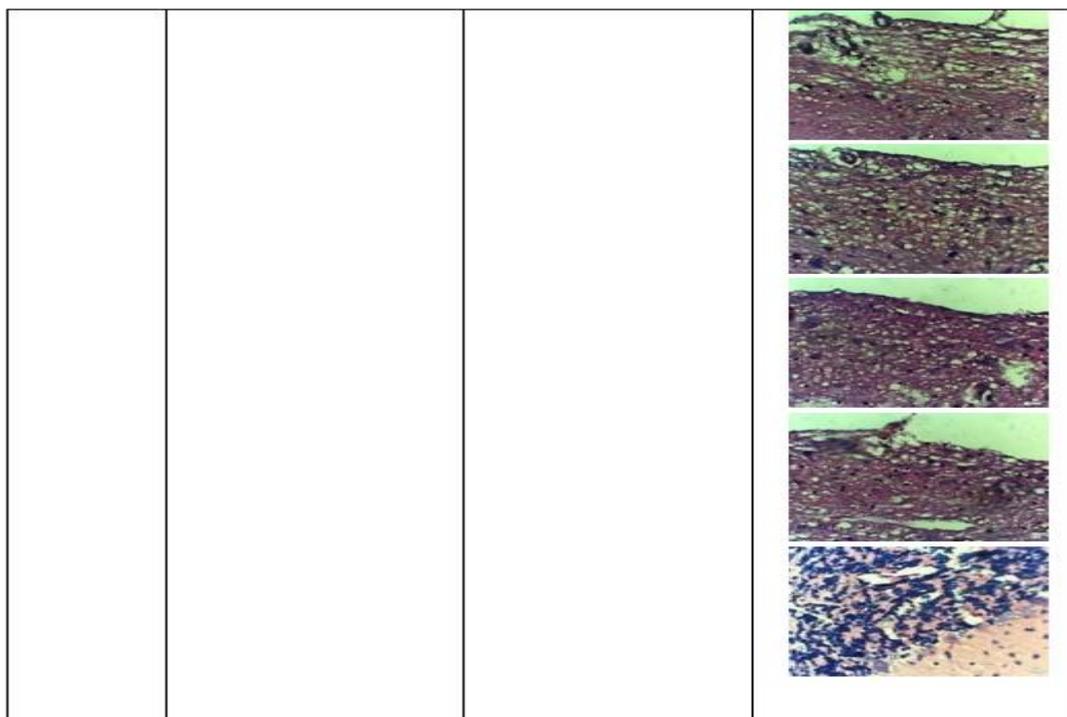


Table: Histopathological Evaluation of Brain Tissue in PTZ-Induced Seizure Model.

Group	Histopathological Findings
G1 – Normal Control	The brain tissue looked completely healthy—neurons kept their normal shape, nuclei were clear, cortical layers were neat, and there was no sign of inflammation.
G2 – PTZ Control	Things got pretty rough here. Neurons shrank and started to fall apart, vacuoles formed in the cytoplasm, and the whole cortical structure broke down. There was a lot of gliosis and inflammatory cells moved in.
G3 – PTZ + Phenytoin	This group showed some improvement. Neurons looked better, with less vacuolization and only mild gliosis. The cortex was more organized compared to the PTZ control but still not perfect.
G4 – PTZ + <i>Crassula ovata</i> (200 mg/kg)	We saw clear improvements. Neurons looked healthier, degenerative changes dropped, inflammation was mild, and the layers of the cortex stayed mostly intact.
G5 – PTZ + <i>Crassula ovata</i> (400 mg/kg)	This group came closest to normal. Neurons were well-preserved, there was barely any vacuolization or inflammation, and the cortical structure bounced back—showing strong neuroprotection.

DISCUSSION

Looking at the tissue samples, it’s obvious that PTZ causes a lot of damage to neurons, mostly through excitotoxicity and oxidative stress. The kind of neurodegeneration seen in rats given PTZ lines up with what other researchers have found about seizures damaging the cortex. But when these rats got *Crassula ovata*, the damage was noticeably less severe.

It’s like the plant extract helped stabilize neurons and dialled down inflammation. This protective effect probably comes from the antioxidants and other active compounds in *C. ovata*. They seem to cut down on oxidative stress and help prevent neurons from dying off. The results are even better with a higher dose (400 mg/kg), which shows there’s a clear dose-response. All these tissue-level improvements make a strong case for using *C. ovata* as a useful add-on in managing epilepsy.

CONCLUSION

The tissue studies make it clear: *Crassula ovata* extract really does protect the brain from PTZ-induced damage. It helps keep neurons intact and cuts down on degeneration, which strongly backs up its potential as an anti-epileptic agent. To really understand how it works, the next step is to look at molecular and immunohistochemical markers.

REFERENCES

1. Rubio, C., Romo-Parra, H., López-Landa, A., & Rubio-Osornio, M., Classification of current experimental models of epilepsy. *Brain Sciences*, 2024; 14(10): 1024. <https://doi.org/10.3390/brainsci14101024>
2. Sumadewi, K. T., Harkitasari, S., & Tjandra, D. C., Biomolecular mechanisms of epileptic seizures and epilepsy. *Acta Epileptologica*, 2023; 5: 28. <https://doi.org/10.1186/s42494-023-00137-0>
3. Łukawski, K., & Czuczwar, S. J., Oxidative stress and neurodegeneration in animal models of seizures. *Antioxidants*, 2023; 12(5): 1049. <https://doi.org/10.3390/antiox12051049>.
4. de Melo, A. D., Freire, V. A. F., Diogo, Í. L., et al., Antioxidant therapy reduces oxidative stress and induces neuroprotection in rodent models of epilepsy: A systematic review. *Antioxidants*, 2023; 12(7): 1397. <https://doi.org/10.3390/antiox12071397>
5. Madireddy, S., & Madireddy, S., Therapeutic strategies to ameliorate neuronal damage in epilepsy by regulating oxidative stress and neuroinflammation. *Brain Sciences*, 2023; 13(5): 784. <https://doi.org/10.3390/brainsci13050784>
6. Kośmider, K., Kamieniak, M., Czuczwar, S. J., & Miziak, B., Second-generation antiepileptic drugs and oxidative stress. *International Journal of Molecular Sciences*, 2023; 24(4): 3873. <https://doi.org/10.3390/ijms24043873>
7. Kim, Y. S., Park, J. H., & Lee, S. J., Establishment of repeated PTZ-induced chronic seizure model and associated histopathological changes in rats. *Inflammation Research*, 2023; 72(4): 589–601. <https://doi.org/10.1007/s00011-023-01689-y>.
8. Sarkisian, M. R., Overview of the PTZ model of epilepsy and associated neuropathology. *Epilepsy & Behavior*, 2001; 2(3): 201–213. <https://doi.org/10.1006/ebeh.2001.0203>.
9. Bancroft, J. D., & Gamble, M. (2019). *Theory and practice of histological techniques* (8th ed.). Elsevier. (Standard reference for H&E staining and histopathological interpretation)
10. WHO Epilepsy: Key facts. World Health Organization, 2024. <https://www.who.int/news-room/fact-sheets/detail/epilepsy>