

Evaluation of Nephroprotective Activity of Soymida Febrifuga Seed Extract against Gentamicin-Induced Nephrotoxicity in Wistar Rats

Sufiyan Khan¹, Rakesh Sharma², Mamta Sharma³, Divya Singh⁴

¹Research Scholar, Department of Pharmacology, Jaipur College of Pharmacy, Jaipur, Rajasthan, India

^{2,3,4}Department of Pharmacology, Jaipur College of Pharmacy, Jaipur, Rajasthan, India

Received: 01-06-2026 / Revised: 15-07-2026 / Accepted: 21-08-2026

Corresponding author: Sufiyan Khan

Conflict of interest: Nil

Abstract

Background: Gentamicin is an effective aminoglycoside antibiotic, but its clinical use is frequently associated with renal tubular injury and oxidative stress. The present study was undertaken to investigate the nephroprotective potential of Soymida febrifuga seed extract against gentamicin-induced nephrotoxicity in Wistar rats.

Materials and Methods: The seeds of Soymida febrifuga were collected, authenticated, dried, powdered, and extracted using a suitable hydroalcoholic extraction procedure. Preliminary phytochemical screening was performed to identify major classes of phytoconstituents. Acute oral toxicity was evaluated according to OECD Guideline 423. Thirty-six Wistar albino rats were divided into six groups of six animals each. Gentamicin was administered at 80 mg/kg, i.p. to induce nephrotoxicity. The extract was administered orally at doses of 100, 200, and 400 mg/kg, while Silymarin was used as the standard drug. Renal function was evaluated by estimating serum creatinine, blood urea nitrogen (BUN), and uric acid. Oxidative stress was assessed by determining superoxide dismutase (SOD), catalase (CAT), and reduced glutathione (GSH) levels in kidney tissue. Histopathological examination of kidney tissues was also performed.

Results: Gentamicin administration produced marked renal injury, as evidenced by increased serum creatinine, BUN, and uric acid levels, accompanied by a reduction in SOD, CAT, and GSH levels. Histopathological examination revealed tubular degeneration, epithelial necrosis, glomerular congestion, and inflammatory changes in the gentamicin-treated group. Treatment with Soymida febrifuga seed extract produced a dose-dependent improvement in renal biochemical parameters and antioxidant status. The 400 mg/kg dose showed the greatest protective effect, with substantial restoration of antioxidant enzyme levels and improvement in renal tissue architecture. The protective response was comparable to that observed with the standard treatment.

Conclusion: The findings suggest that Soymida febrifuga seed extract possesses significant nephroprotective and antioxidant activity against gentamicin-induced renal injury in Wistar rats. The protective effect may be associated with the presence of biologically active phytoconstituents such as flavonoids, phenolics, tannins, saponins, alkaloids, and terpenoids. Further studies are required to identify the active constituents and elucidate the precise molecular mechanisms responsible for the nephroprotective activity.

Keywords: Soymida Febrifuga, Nephroprotective Activity, Gentamicin, Nephrotoxicity, Antioxidant Enzymes.

DOI: 10.25258/ijcpr.18.9.166

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

The kidneys are part of the urinary system, which also includes the ureters, urinary bladder, and urethra. These organs collectively function to eliminate waste products from the body in the form of urine. The kidneys are paired, bean-shaped organs located in the retroperitoneal space on either

side of the vertebral column. The right kidney is slightly lower than the left due to the presence of the liver. The kidneys are protected by the lower ribs, surrounding adipose tissue, and a fibrous renal capsule that provides structural support and protection against injury.

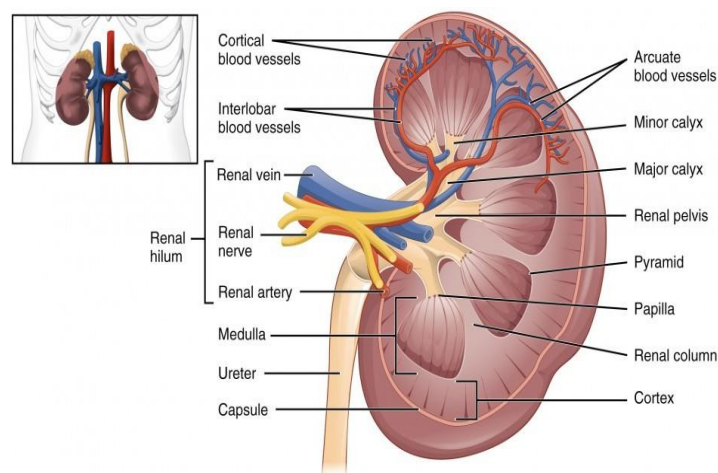


Figure 1: Anatomy of Kidney

Nephrotoxicity: Nephrotoxicity refers to kidney damage caused by exposure to toxic substances such as drugs, chemicals, heavy metals, and environmental toxins. The kidneys are highly vulnerable to toxic injury because they receive a large portion of the cardiac output and play a major role in filtering and concentrating substances from the blood. Due to this filtration process, many toxic compounds accumulate in renal tissues and may cause structural and functional damage to the kidneys.

Plant Profile of *Soymida febrifuga*: *Soymida febrifuga* (Roxb.) A. Juss. is an important medicinal plant belonging to the family Meliaceae. It is commonly known as Indian red cedar and has been traditionally used in Ayurvedic and folk medicine for the treatment of various diseases. Different parts of the plant such as bark, leaves, seeds, and roots have been reported to possess several pharmacological properties including anti-inflammatory, antimicrobial, antioxidant, antidiabetic, and hepatoprotective activities.



Figure 2: Plant Profile

The plant is widely distributed in tropical and subtropical regions of India and has been used in traditional medicine for centuries.

The presence of various bioactive compounds such as flavonoids, alkaloids, terpenoids, and phenolic compounds contributes to its medicinal value.

These phytoconstituents are known for their antioxidant and cytoprotective activities, which may help in protecting tissues from oxidative damage.

Because oxidative stress plays a major role in gentamicin-induced nephrotoxicity, medicinal plants rich in antioxidant compounds may help protect renal tissues from damage. Therefore, *Soymida febrifuga* is considered a promising

candidate for evaluating its nephroprotective activity.

Pharmacological Activities: Various pharmacological studies have demonstrated the therapeutic potential of *Soymida febrifuga*. Some of the reported activities include:

Antioxidant Activity: Plant extracts have been reported to possess strong antioxidant activity due to the presence of phenolic compounds and flavonoids.

Anti-inflammatory Activity: Extracts of the plant have shown anti-inflammatory effects by inhibiting inflammatory mediators.

Antimicrobial Activity: The plant has demonstrated antimicrobial activity against various bacterial and fungal pathogens.

Antidiabetic Activity: Some studies have reported that extracts of *Soymida febrifuga* may help reduce blood glucose levels.

Hepatoprotective Activity: Plant extracts have also been reported to protect liver tissues from chemical-induced damage. Due to these pharmacological properties, *Soymida febrifuga* is considered a promising medicinal plant for evaluating its nephroprotective activity.

Collection and Authentication of Plant Material: The mature dried seeds of *Soymida febrifuga* were collected during the month of Feb. from Local Area in Jaipur. The collected plant material was taxonomically identified and authenticated by a qualified taxonomist at the Botanical department.

Experimental Animals: Healthy adult Wistar rats of either sex weighing approximately 150–200gm were selected for the present experimental study. The animals were procured from a registered animal house facility approved by the Committee for Control and Supervision of Experiments on Animals (CCSEA), Government of India.

Induction of Nephrotoxicity: Nephrotoxicity was be experimentally induced in Wistar rats using gentamicin to produce renal damage when administered in high doses or for prolonged periods. Gentamicin is frequently used in experimental studies to induce nephrotoxicity because it causes structural and functional damage to the renal tubular cells.

Experimental Design (Animal Grouping): After the acclimatization period, the experimental animals were randomly divided into six groups, each consisting of Six Wistar rats (n = 6).

Table 1: Experimental Animal Grouping

Group	Treatment	Dose	Route of Administration
Group I	Normal Control	Normal saline (1 mL/kg)	Oral (p.o.)
Group II	Gentamicin Control	Gentamicin 80 mg/kg	Intraperitoneal (i.p.)
Group III	Standard Drug + Gentamicin	Silymarin 100 mg/kg + Gentamicin 80 mg/kg	Silymarin: Oral (p.o.); Gentamicin: Intraperitoneal (i.p.)
Group IV	<i>Soymida febrifuga</i> Seed Extract (Low Dose) + Gentamicin	Extract 100 mg/kg + Gentamicin 80 mg/kg	Extract: Oral (p.o.); Gentamicin: Intraperitoneal (i.p.)
Group V	<i>Soymida febrifuga</i> Seed Extract (Medium Dose) + Gentamicin	Extract 200 mg/kg + Gentamicin 80 mg/kg	Extract: Oral (p.o.); Gentamicin: Intraperitoneal (i.p.)
Group VI	<i>Soymida febrifuga</i> Seed Extract (High Dose) + Gentamicin	Extract 400 mg/kg + Gentamicin 80 mg/kg	Extract: Oral (p.o.); Gentamicin: Intraperitoneal (i.p.)

Collection of Blood Samples: At the end of the experimental period, the animals were fasted overnight but allowed free access to water. Blood samples were collected from the experimental animals for the estimation of renal biochemical parameters. Prior to blood collection, the animals were lightly anesthetized to minimize pain and stress during the procedure. Blood samples were collected from the retro-orbital plexus using sterile capillary tubes.

Evaluation of Renal Biochemical Parameters: After collection and separation of serum from blood samples, various renal biochemical parameters were estimated in order to assess kidney function and the extent of nephrotoxicity induced by gentamicin. These biochemical markers are widely used indicators for evaluating renal

damage and the protective effects of nephroprotective agents.

Statistical Analysis: The statistical analysis of the data was carried out using one-way analysis of variance (ANOVA) followed by suitable post hoc tests such as Dunnett's test or Tukey's multiple comparison test.

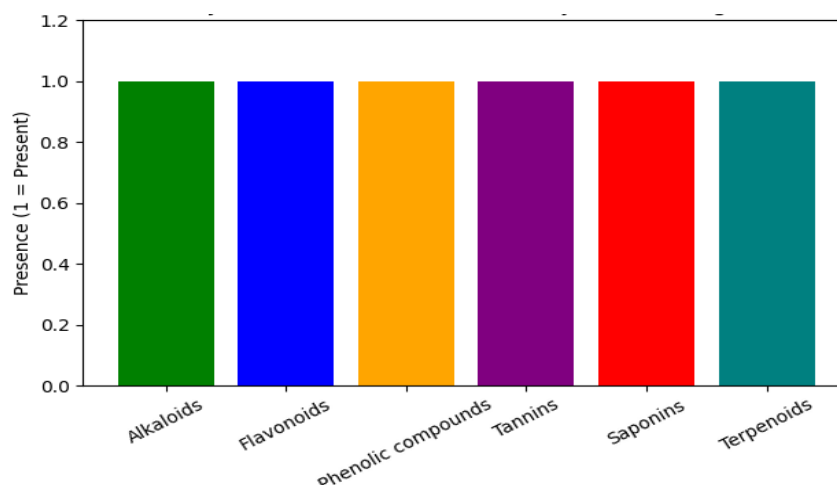
A p-value less than 0.05 ($p < 0.05$) was considered statistically significant.

Results

Preliminary Phytochemical Screening: Preliminary phytochemical screening of the ethanolic extract of *Soymida febrifuga* seeds was carried out using standard qualitative chemical tests to detect the presence of major phytoconstituents.

Table 2: Preliminary Phytochemical Screening of *Soymida febrifuga* Seed Extract

S. No.	Phytochemical Test	Observation	Result
1	Dragendorff's test	Orange precipitate	Alkaloids present
2	Mayer's test	Cream precipitate	Alkaloids present
3	Shinoda test	Pink coloration	Flavonoids present
4	Ferric chloride test	Blue-green color	Phenolic compounds present
5	Gelatin test	White precipitate	Tannins present
6	Foam test	Persistent foam	Saponins present
7	Salkowski test	Reddish-brown interface	Terpenoids present

**Figure 3: Graphical representation of the Phytochemical Screening**

The presence of these phytochemicals supports the potential pharmacological activity of the plant extract and justifies its further evaluation for nephroprotective activity in experimental animals.

Acute Oral Toxicity Study: The acute oral toxicity study of the seed extract of *Soymida febrifuga* was performed according to OECD Guideline 423.

The extract was administered orally at a limit dose of 2000mg/kg body weight and the animals were observed for 14 days. No mortality was observed during the observation period.

Collection of Blood Samples: Blood was withdrawn from the retro-orbital plexus using

sterile capillary tubes and transferred into clean, dry centrifuge tubes. The clear serum obtained was collected carefully and stored at 4°C until used for biochemical estimations such as serum creatinine, blood urea nitrogen (BUN), and uric acid.

Biochemical Results

Renal biochemical parameters were estimated in serum samples collected from all experimental groups. Gentamicin administration produced a marked increase in serum creatinine, BUN, and uric acid levels in the toxic control group, confirming induction of nephrotoxicity.

Table 3: Effect of *Soymida febrifuga* Seed Extract on Renal Biochemical Parameters

Group	Treatment	Serum Creatinine (mg/dL)	BUN (mg/dL)	Uric Acid (mg/dL)
Group I	Normal control	0.62 ± 0.05	18.4 ± 1.2	2.3 ± 0.2
Group II	Gentamicin control	2.85 ± 0.14	64.6 ± 2.5	6.7 ± 0.3
Group III	Standard drug + gentamicin	0.95 ± 0.07	26.3 ± 1.6	3.1 ± 0.2
Group IV	Extract 100 mg/kg + gentamicin	1.72 ± 0.09	43.8 ± 2.1	4.8 ± 0.3
Group V	Extract 200 mg/kg + gentamicin	1.28 ± 0.08	35.6 ± 1.9	3.9 ± 0.2
Group VI	Extract 400 mg/kg + gentamicin	0.88 ± 0.06	24.9 ± 1.4	3.0 ± 0.2

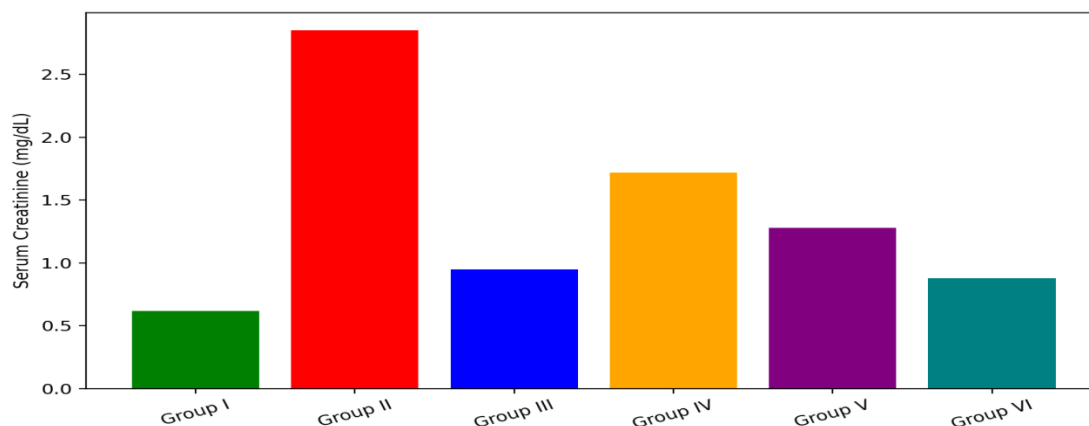


Figure 4: Graphical representation of the Serum Creatinine Levels

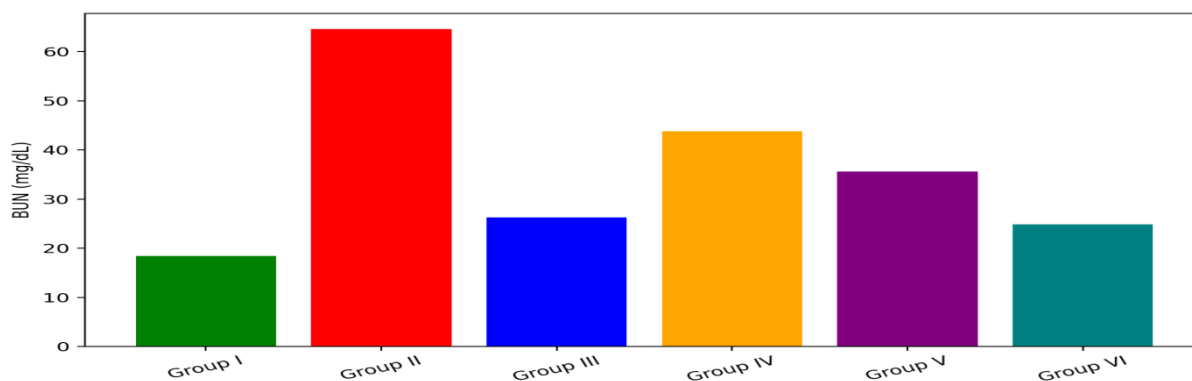


Figure 5: Graphical representation of the (BUN)

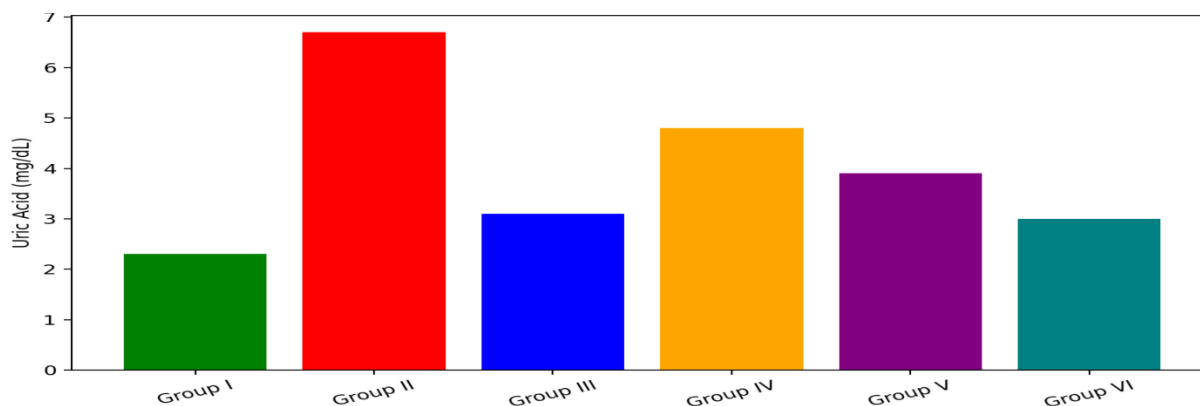


Figure 6: Graphical representation of the Uric Acid

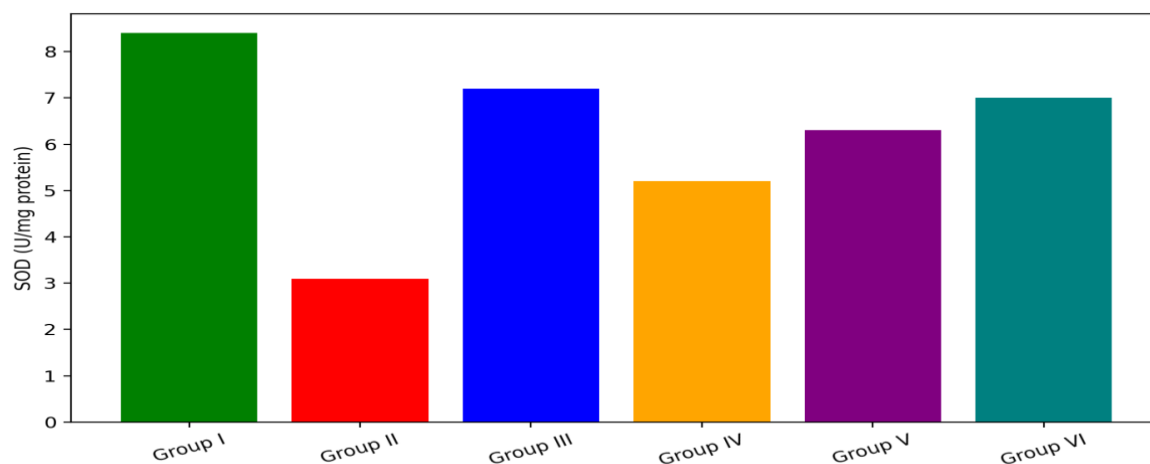
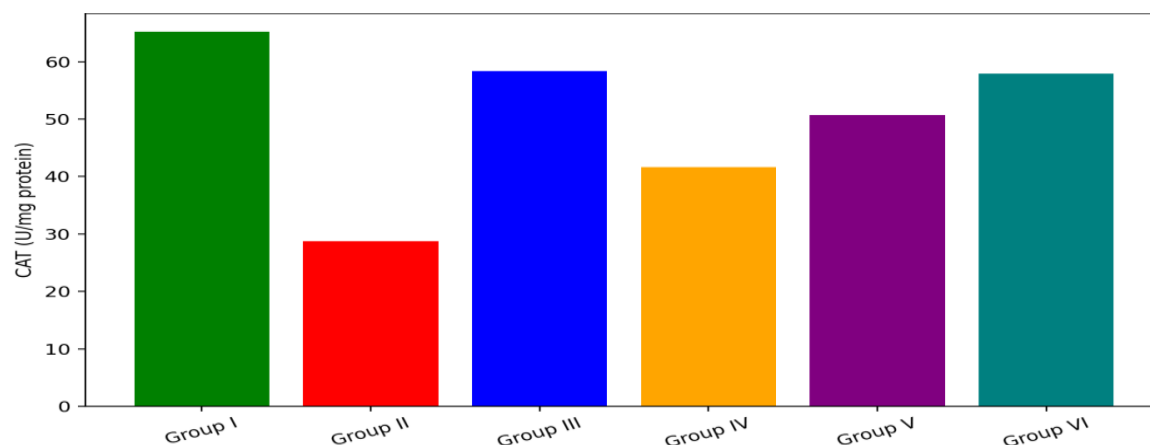
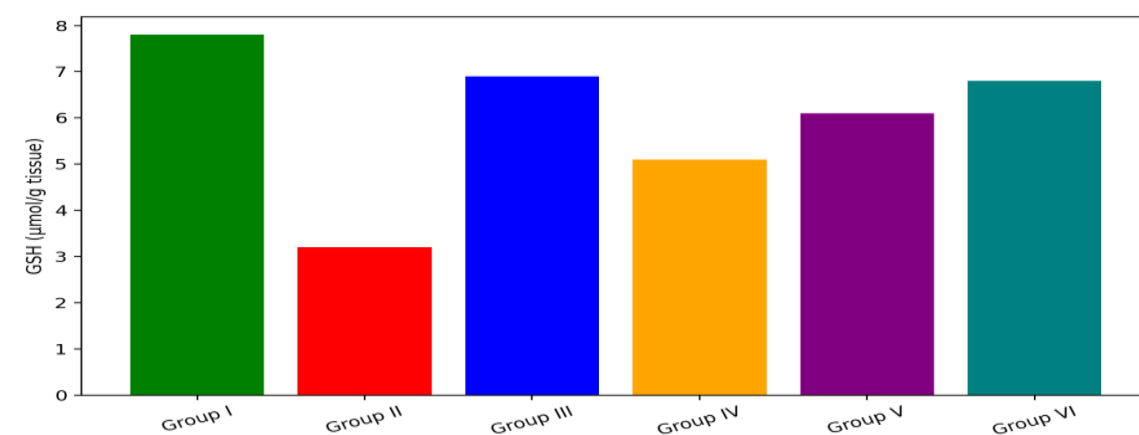
The Toxic control group (Group II) showed a significant rise in serum creatinine, BUN, and uric acid levels compared to the normal control group, indicating severe renal damage caused by gentamicin.

The standard drug group (Group III) showed marked protection against gentamicin-induced nephrotoxicity. Among the extract-treated groups, Group VI (400 mg/kg) showed the maximum reduction in renal biochemical parameters and produced results close to the standard group, suggesting that the nephroprotective effect of *Soyimida febrifuga* seed extract is dose dependent.

Estimation of Antioxidant Enzymes: The antioxidant status of kidney tissues was evaluated by estimating the levels of superoxide dismutase (SOD), catalase (CAT), and reduced glutathione (GSH) in all experimental groups. Gentamicin administration caused a marked decrease in these antioxidant enzymes in the toxic control group, indicating severe oxidative stress and renal tissue damage. Treatment with *Soyimida febrifuga* seed extract significantly restored the levels of these antioxidant enzymes in a dose-dependent manner, suggesting its antioxidant and nephroprotective potential.

Table 4: Effect of Soyamida febrifuga Seed Extract on Antioxidant Enzymes in Gentamicin-Induced Nephrotoxicity

Group	Treatment	SOD (U/mg protein)	CAT (U/mg protein)	GSH ($\mu\text{mol/g}$ tissue)
Group I	Normal control	8.4 ± 0.4	65.2 ± 2.6	7.8 ± 0.5
Group II	Gentamicin control	3.1 ± 0.2	28.7 ± 1.8	3.2 ± 0.3
Group III	Standard drug + gentamicin	7.2 ± 0.3	58.4 ± 2.3	6.9 ± 0.4
Group IV	Extract 100 mg/kg + gentamicin	5.2 ± 0.3	41.6 ± 2.0	5.1 ± 0.3
Group V	Extract 200 mg/kg + gentamicin	6.3 ± 0.4	50.7 ± 2.2	6.1 ± 0.3
Group VI	Extract 400 mg/kg + gentamicin	7.0 ± 0.3	57.9 ± 2.4	6.8 ± 0.4

**Figure 7: Graphical representation of the SOD Levels****Figure 8: Graphical representation of the CAT Levels****Figure 9: Graphical representation of the GSH levels**

The gentamicin-treated toxic control group showed a significant reduction in all antioxidant enzyme levels due to increased oxidative stress produced by gentamicin. The standard drug-treated group showed considerable restoration of antioxidant enzymes, confirming protection against renal oxidative damage. Among the extract-treated groups, Group IV (100 mg/kg) showed moderate improvement, while Group V (200 mg/kg) showed better restoration of antioxidant status. Group VI (400 mg/kg) showed maximum improvement, with antioxidant enzyme levels approaching those of the

standard group. This indicates that *Soyimida febrifuga* seed extract possesses significant antioxidant activity and protects renal tissues from gentamicin-induced oxidative damage in a dose-dependent manner.

Histopathological

Examination:

Histopathological examination of kidney tissues was performed to evaluate the structural changes produced by gentamicin-induced nephrotoxicity and to assess the protective effect of *Soyimida febrifuga* seed extract.

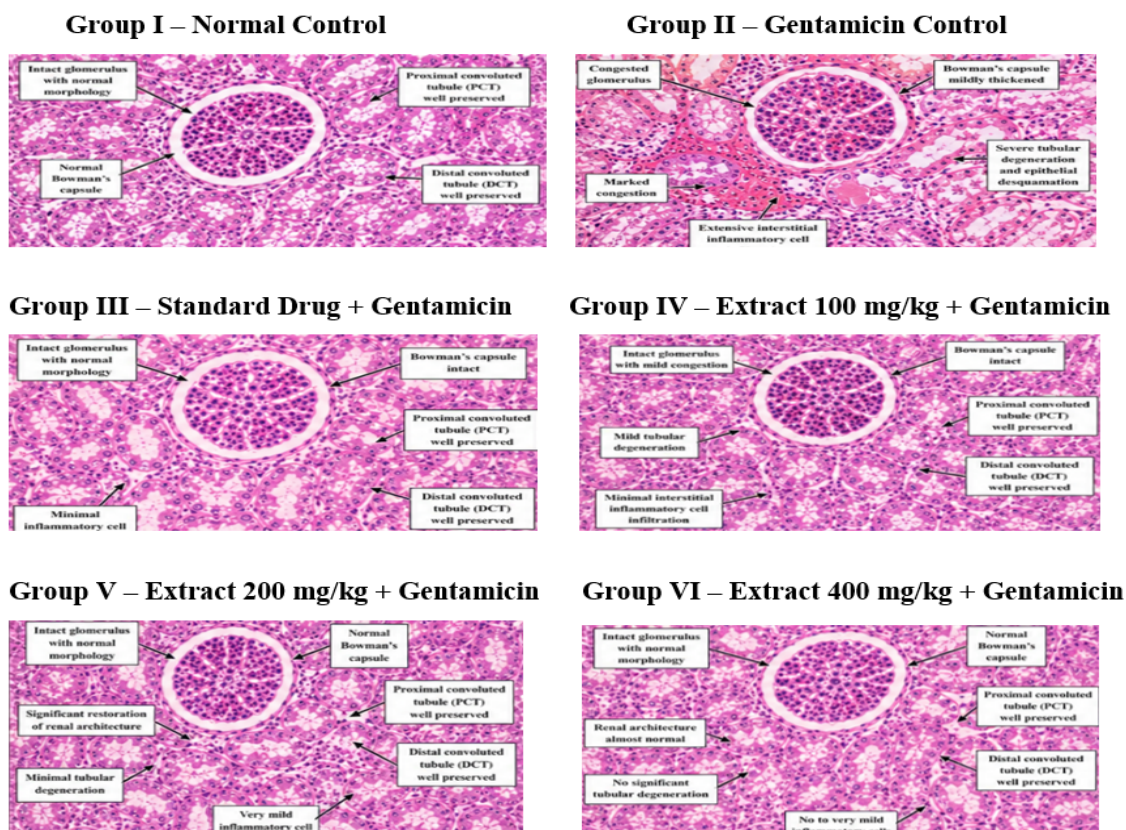


Figure 10: Microscopic Examination of Different Groups

Group I – Normal Control: Microscopic examination of kidney tissue from the normal control group showed normal renal architecture. No inflammatory cell infiltration or congestion was observed.

Group II – Gentamicin Control: The gentamicin-treated toxic control group showed severe pathological changes. There was marked tubular degeneration, necrosis of renal tubular epithelial cells, glomerular congestion, and interstitial inflammatory cell infiltration.

Group III – Standard Drug + Gentamicin: The standard-treated group showed considerable protection against gentamicin-induced renal damage. The renal tissue exhibited near-normal glomeruli and tubules with only mild tubular degeneration. Inflammatory infiltration and

necrotic changes were greatly reduced compared with the toxic control group.

Group IV – Extract 100 mg/kg + Gentamicin: The low-dose extract-treated group showed moderate improvement in renal histology. Mild tubular degeneration and slight inflammatory changes were observed. The glomeruli appeared relatively preserved, and tissue damage was less severe than in the gentamicin control group.

Group V – Extract 200 mg/kg + Gentamicin: The medium-dose extract-treated group showed significant restoration of renal architecture. The glomeruli and renal tubules appeared almost normal, with only minimal tubular degeneration and mild inflammatory infiltration. The tissue damage was markedly reduced compared with Group II.

Group VI – Extract 400 mg/kg + Gentamicin:

The high-dose extract-treated group showed almost normal renal histology. The glomeruli were intact, Bowman's space was normal, and the renal tubules were well preserved. Only very mild pathological changes were seen, indicating maximum nephroprotective effect of the extract.

The histopathological findings clearly indicate that gentamicin caused severe renal damage in the toxic control group, as evidenced by tubular necrosis, degeneration, and inflammatory changes. Treatment with *Soymida febrifuga* seed extract significantly reduced these pathological alterations in a dose-dependent manner.

The high-dose extract group showed maximum protection and almost restored normal renal histology, confirming the nephroprotective potential of the plant extract.

Discussion

The present study demonstrated that gentamicin induced marked renal injury, as indicated by increased serum creatinine, BUN and uric acid levels. Gentamicin also reduced SOD, CAT and GSH levels, confirming the involvement of oxidative stress in renal damage. Treatment with *Soymida febrifuga* seed extract improved renal biochemical parameters and restored antioxidant status in a dose-dependent manner. Histopathological findings further supported the protective effect of the extract by showing reduced tubular degeneration and improved renal architecture. Overall, the 400 mg/kg dose showed the greatest nephroprotective effect, suggesting that *Soymida febrifuga* may be a promising natural source for protection against gentamicin-induced nephrotoxicity.

Conclusion

The findings suggest that *Soymida febrifuga* seed extract possesses significant nephroprotective and antioxidant activity against gentamicin-induced renal injury in Wistar rats. The protective effect may be associated with the presence of biologically active phytoconstituents such as flavonoids, phenolics, tannins, saponins, alkaloids, and

terpenoids. Further studies are required to identify the active constituents and elucidate the precise molecular mechanisms responsible for the nephroprotective activity.

References

1. Hall JE. Guyton and Hall Textbook of Medical Physiology. 14th ed. Philadelphia: Elsevier; 2021.
2. Brenner BM, Rector FC. Brenner and Rector's The Kidney. 10th ed. Philadelphia: Elsevier; 2016.
3. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd ed. Dehradun: International Book Distributors; 2016.
4. Nadkarni KM. Indian Materia Medica. 3rd ed. Mumbai: Popular Prakashan; 2015.
5. Sharma OP. Plant Taxonomy. 2nd ed. New Delhi: McGraw Hill; 2017.
6. Khare CP. Indian Medicinal Plants: An Illustrated Dictionary. Springer; 2016.
7. Harborne JB. Phytochemical Methods. 3rd ed. Springer; 2015.
8. Warrier PK. Indian Medicinal Plants: A Compendium of 500 Species. Orient Longman; 2016.
9. Evans WC. Trease and Evans Pharmacognosy. 16th ed. Elsevier; 2019.
10. Ali BH, Al-Salmi I. Natural antioxidants in nephroprotection. *Oxidative Medicine and Cellular Longevity*. 2021;2021:6676745.
11. Rang HP, Dale MM, Ritter JM, Flower RJ. Rang and Dale's Pharmacology. 9th ed. Elsevier; 2020.
12. Tripathi KD. Essentials of Medical Pharmacology. 8th ed. Jaypee Brothers Medical Publishers; 2019.
13. Burtis CA, Ashwood ER, Bruns DE. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 6th ed. Elsevier; 2018.
14. Jain NK. Laboratory Manual of Pharmacology. CBS Publishers; 2016.
15. Burtis CA, Ashwood ER, Bruns DE. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 6th ed. Elsevier; 2018.