FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 10 No. 18, September, 2026, pp 93 – 99
DOI: https://doi.org/10.33003/fjs-2026-1018-6032

Hepatoprotective Effect of *Cochlospermum Planchonii* Methanol Root Extract in Albino Rats

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Received: 28 Jul. 2026
Accepted: 12 Sep. 2026
Published: 21 Sep. 2026

ABSTRACT
Across much of West Africa, root and rhizome decoctions of *Cochlospermum planchonii* are used to manage jaundice and other liver-related complaints, yet this folk use has not been widely tested under controlled experimental conditions. This study was designed to evaluate the hepatoprotective activity of methanol root extract of *C. planchonii* in albino rats, conducted between March to April 2026. Fresh roots were harvested, botanically authenticated, air-dried, and macerated in methanol to obtain the extract. Percentage yield was determined and a qualitative phytochemical screening was performed (Harborne, 1973; Trease and Evans, 1989). Acute oral toxicity was assessed at 5000 mg/kg. Thirty albino rats were assigned to six groups: a normal control, a disease (negative) control, a silymarin-treated positive control (1.07 mg/kg), and three extract-treated groups (100, 200, and 400 mg/kg body weight). Serum liver-function markers (AST, ALT, ALP, albumin, total protein, and total and direct bilirubin) were measured, and liver tissue was examined histologically. Data were analyzed by one-way ANOVA. Extraction yielded 11.54% of a dark-green, water-soluble concentrate containing tannins, flavonoids, alkaloids, cardiac glycosides, steroids, and saponins. No mortality occurred at 5000 mg/kg, placing the LD^{50} above this dose. AST was significantly elevated in the negative control and in the 100 and 200 mg/kg extract groups, whereas the 400 mg/kg group showed AST values comparable to the normal control; ALT and ALP did not differ significantly among groups. Histology showed better-preserved liver architecture and reduced inflammatory change in the extract-treated animals, most evident at 400 mg/kg. These findings indicate that the methanol root extract of *C. planchonii* confers measurable, dose-related hepatoprotection, supporting its traditional ethnomedicinal use.

Keywords: *Cochlospermum planchonii*, Hepatoprotective, Toxicity, Phytochemicals, Albino Rats, Methanol Extract

INTRODUCTION

Long before modern pharmacology existed, people already looked to plants to treat illness, and that reliance has only deepened in recent decades, as documented by Giannenas et al. (2020). Low cost and ready availability keep many such preparations in everyday use, notwithstanding the fact that few have been subjected to rigorous clinical testing. The World Health Organization puts the proportion of the global population relying mainly on plant-based traditional medicine for primary care above 80%, and interest in herbal therapy has continued to climb in recent years (Barkat et al., 2021).

Few organs match the structural and functional complexity of the liver, an intricacy that reflects its central role in whole-body homeostasis (Hassani, 2022). Carbohydrate, protein, and lipid metabolism all pass through it, and it serves as the principal site for clearing ammonia, other metabolic by-products, and administered drugs from the circulation. It also works alongside the spleen to remove aged red blood cells and recover their components (Thiagarajan et al., 2021), and supports processes as varied as growth, immune defense, nutrient handling, energy production, and reproduction (Patil et al., 2021). This same metabolic versatility, combined with its direct anatomical link to the gut, leaves the liver unusually exposed to injury from drugs and other exogenous substances (Mega et al., 2021).

The term hepatotoxicity covers liver injury and impaired liver function that follow exposure to a drug or other non-infectious agent (Brooks et al., 2022). Because many hepatotoxic agents act directly on hepatocytes, they can generate almost any recognized pattern of liver pathology, and drugs and toxins together explain a large share of acute liver failure cases (Tujios et al., 2022). Acetaminophen, carbon tetrachloride, galactosamine, and thioacetamide are among the agents routinely chosen to model hepatocellular injury in vivo and in vitro; of these, the halogenated hydrocarbon carbon tetrachloride (CCl4) is probably the best-characterized hepatotoxicant used in animal studies (Yousuf et al., 2023).

When CCl4 is metabolized, it yields trichloromethyl free radicals that injure hepatic tissue directly (Unsal et al., 2021) and set off lipid peroxidation in liver cell membranes, compounding the damage (Recknagel et al., 2020). Much of the oxidative stress that follows can be traced to reactive oxygen species outpacing the body's antioxidant defenses. If left unchecked, this stress damages tissue, drives cell death, and blunts the capacity to clear toxic compounds. Prolonged, severe stress of this kind can compromise organ function, the liver included (Zhang et al., 2022). The growing worldwide burden of liver disease has, in turn, renewed interest in medicinal plants as a source of treatment (Xu et al., 2020).

Plants remain a mainstay of health maintenance and disease management worldwide (WHO, 2021), and the expanding evidence base is now prompting more systematic scientific scrutiny of these remedies. Documented medicinal applications exist for roughly 7,500 plant species within traditional health systems, most notably in rural and indigenous communities (Dipika et al., 2021), yet the pharmacology underlying an estimated 4,000 of them is still poorly defined. Closing that gap through careful investigation, scientific validation, and proper documentation is essential if plant-derived treatments for serious disease are to be developed further (Recknagel et al., 2020).

Plants continue to serve as an important source of chemical leads for new medicines, including candidate anticancer agents, and the same phytochemicals are often responsible for both the benefits and the toxicities that plants can produce in the body (Adebayo et al., 2023). Many of these compounds are thought to have evolved as chemical defenses against herbivores, an origin that does not preclude a subsequent benefit to humans.

Cochlospermum planchonii, a member of the family Cochlospermaceae, is a savanna shrub reaching roughly 2–4 m in height, with characteristic trilobed leaves and bright yellow flowers borne close to the base of the stem (Burkill, 1985). It is widespread across the West African savanna belt from Senegal to Cameroon; within Nigeria, it occurs commonly in Kogi and Benue States. The root and rhizome are the parts most valued in traditional medicine: decoctions are used across the region to manage jaundice and other hepatobiliary complaints, alongside malaria, diabetes, and diarrhoea (Burkill, 1985). This study was therefore undertaken to evaluate the hepatoprotective effect of a methanol root extract of Cochlospermum planchonii in albino rats.

MATERIALS AND METHODS

Collection and Identification of Plant Sample

Fresh roots of *Cochlospermum planchonii* were collected in March, 2026 from Zuru Local Government Area, Kebbi State, Nigeria and taken to the herbarium unit of the Department of Crop Science, Federal University of Agriculture, Zuru, where a taxonomist identified and authenticated the specimen. A voucher specimen number (FUAZ/CRPSC/H/019) was assigned to the specimen and was deposited at the herbarium for future reference.

Plant Preparation and Extraction

Roots were air-dried at room temperature for two weeks and ground to a powder using a mortar and pestle. A 130g portion of the powdered material was macerated in 1 liter of methanol in an air-tight container for 72 hours. The macerate was filtered through sterile muslin cloth and the filtrate was concentrated using a rotary evaporator at 45°C before further drying in a drying cabinet at the same temperature. The resulting methanol extract was weighed using analytical weighing balance to determine yield and stored in an air-tight container at -4°C until required for analysis. Percentage yield was calculated as:

Percentage yield = (weight of extract ÷ weight of ground plant material) × 100

Qualitative Phytochemical Screening

The Phytochemical screening for the presence of saponins, tannins, alkaloids, flavonoids, steroids, and glycosides were carried out according to the methods described by Harborne (1973) and Trease and Evans (1989).

Experimental Animal

Wistar albino rats male were obtained from the Animal House of Ahmadu Bello University (ABU) Zaria, Kaduna State, in march 2026 and transported in ventilated plastic cages to the Animal House of the Faculty of Science, Federal University of Agriculture, Zuru, Kebbi State. The animals were acclimatized for two weeks before the start of the experiment, the animals were feed with standard rodent pellets and given free access to water.

Toxicity Studies

Acute Oral Toxicity Test (LD50 Determination)

Acute oral toxicity was assessed following Organisation for Economic Co-operation and Development (OECD) guideline 423 (OECD, 2001). Six rats were used, one per group, and fasted overnight with only water provided. The first group received distilled water orally and served as the normal control; the remaining five rats each received a single oral dose of 5000 mg/kg body weight of the extract. Animals were observed systematically at 8 and 48 hours and daily thereafter for up to 14 days for signs of toxicity, including weakness, aggression, food refusal, weight loss, skin changes, hair loss, laboured breathing, and mortality.

Hepatoprotective Study of *Cochlospermum planchonii* Root Extract

Induction of Hepatotoxicity

Paracetamol one tablet of 500mg was dissolved in distilled water and administered orally to the animals at 500 mg/kg body weight daily for 14 days to induce hepatotoxicity.

Experimental Design for Induction

Hepatotoxicity was induced with minor modification of the method of Guntupalli *et al.* (2004). Thirty albino rats were assigned to six groups of five animals each, and liver injury was induced by daily oral administration of paracetamol (600 mg/kg body weight), with groups treated as follows:

Group I: Received distilled water (5 mL/kg body weight) once daily for 14 days; served as normal control.

Group II: Received paracetamol (600 mg/kg body weight) once daily for 14 days; served as disease (negative) control.

Group III: Received paracetamol (600 mg/kg) plus the standard drug silymarin (100 mg/kg body weight) once daily for 14 days; served as positive control.

Group IV: Received paracetamol (600 mg/kg) plus methanol extract of *C. planchonii* (100 mg/kg body weight) once daily for 14 days; treatment group.

Group V: Received paracetamol (600 mg/kg) plus methanol extract of *C. planchonii* (200 mg/kg body weight) once daily for 14 days; treatment group.

Group VI: Received paracetamol (600 mg/kg) plus methanol extract of *C. planchonii* (400 mg/kg body weight) once daily for 14 days; treatment group.

All groups except Group I received paracetamol followed by their respective treatment, with minor modification of the method of Tabassum and Agrawal (2004). The rats were sacrificed on day 15 of the experiment. Blood samples were collected in heparinised bottles for Blood, kidney and liver samples.

Biochemical Assay

Liver function was assessed by measuring total protein (Lowry *et al.*, 1951), albumin, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) (Reitman and Frankel, 1957), alkaline phosphatase (ALP) (Sood, 1999), and total and direct bilirubin (Jendrassik and Grof, 1938).

Data Analysis
Data are expressed as mean ± standard error of the mean (SEM) and were analysed by one-way analysis of variance (ANOVA), with Duncan's multiple range test used to separate means, using SPSS version 20. Differences were considered statistically significant at $P< 0.05$.

RESULTS AND DISCUSSION

Extraction and Percentage Yield
Extraction of 130 g of *Cochlospermum planchonii* root in 1000 mL of methanol gave an 11.54% yield of a dark-green, water-soluble extract with a sticky texture. Percentage yield was calculated as: Percentage yield = (weight of extract ÷ weight of ground plant material) × 100.

Qualitative Phytochemical Screening
Phytochemical analysis of the methanol root extract confirmed the presence of tannins, flavonoids, alkaloids, cardiac glycosides, steroids, and saponins (Table 1).

Table 1: Qualitative Phytochemical Composition of the Methanol Root Extract of *Cochlospermum planchonii*

S/No	Phytochemical	Results
1	Saponins	+
2	Tannins	+
3	Flavonoids	+
4	Alkaloids	+
5	Cardiac glycosides	+
6	Steroids	+

Acute Oral Toxicity Effect of the Methanol Root Extract
No mortality or observable behavioural changes occurred during the 14-day observation period following a single 5000 mg/kg oral dose of the methanol root extract. The LD^{50} of the *Cochlospermum planchonii* methanol root extract was therefore estimated to exceed 5000 mg/kg body weight.

Hepatoprotective Effect on Biomarkers of Liver Function
The results of the hepatoprotective effect of *C. planchonii* are presented in Table 2. Aspartate aminotransferase (AST) was significantly elevated ($P< 0.05$) in the negative control and in the 100 and 200 mg/kg extract groups relative to the normal control, whereas the positive control and the 400 mg/kg extract group did not differ significantly ($P> 0.05$) from the normal control. Alanine aminotransferase (ALT) and alkaline phosphatase (ALP) showed non-significant increases ($P> 0.05$) across all treated groups relative to the normal control (Table 2). Albumin did not differ significantly among the extract-treated groups or the negative control relative to the normal control, although the positive control showed a significant increase ($P< 0.05$). Total protein was likewise unchanged in the 200 and 400 mg/kg extract groups and the negative control but significantly increased ($P< 0.05$) in the positive control and the 100 mg/kg group relative to the normal control. Total bilirubin significantly increased ($P< 0.05$) only in the 100 mg/kg extract group, while direct bilirubin was unchanged in the 200 and 400 mg/kg groups and the negative control but significantly reduced ($P< 0.05$) in the positive control and the 100 mg/kg group relative to the normal control.

Table 2: Hepatoprotective Effect of the Methanol Root Extract of *Cochlospermum planchonii* on Liver Function Parameters in Albino Rats

Parameter	Normal Control	Negative Control	Positive Control (Sylmarine 1.07mg/kg)	CPRME (100mg/kg)	CPRME (200mg/kg)	CPRME (400mg/kg)
AST (U/L)	144.75 ± 14.57^{a}	225.46 ± 7.89^{b}	173.89 ± 28.65^{ab}	221.80 ± 0.63^{b}	228.61 ± 3.28^{b}	167.18 ± 7.78^{a}
ALT (U/L)	62.28 ± 0.03^{a}	69.73 ± 1.99^{a}	72.17 ± 1.06^{a}	81.84 ± 3.52^{a}	97.35 ± 2.33^{a}	27.91 ± 67.59^{a}
ALP (U/L)	63.48 ± 5.75^{a}	93.84 ± 13.89^{ab}	73.67 ± 3.30^{a}	69.57 ± 4.78^{b}	62.56 ± 7.53^{a}	82.80 ± 5.75^{a}
ALB (G/l)	2.01 ± 0.11^{a}	2.29 ± 0.17^{ab}	2.72 ± 0.28^{b}	2.12 ± 0.05^{ab}	2.14 ± 0.23^{ab}	2.22 ± 0.28^{ab}
TP (G/l)	3.08 ± 0.17^{a}	4.10 ± 0.06^{ab}	4.42 ± 0.21^{b}	4.68 ± 0.15^{b}	3.22 ± 0.63^{a}	3.86 ± 0.28^{ab}
TB (mg/dL)	3.53 ± 0.05^{ab}	3.31 ± 0.45^{a}	3.75 ± 0.05^{abc}	4.89 ± 0.43^{c}	3.98 ± 0.42^{abc}	4.84 ± 0.63^{bc}
DB (mg/dL)	1.20 ± 0.01^{c}	0.93 ± 0.16^{bc}	0.78 ± 0.04^{a}	0.83 ± 0.07^{a}	1.10 ± 0.01^{bc}	1.19 ± 0.02^{c}

Values are mean ± SEM (n = 4); values sharing the same superscript letter within a row are not significantly different ($P> 0.05$), analyzed by one-way ANOVA followed by Duncan's multiple range test (SPSS v20). AST = aspartate aminotransferase; ALT = alanine aminotransferase; ALP = alkaline phosphatase; ALB = albumin; TP = total protein; TB = total bilirubin; DB = direct bilirubin; CPRME = *C. planchonii* root methanol extract.

Effect of the Methanol Root Extract on Liver Histology
Histological findings for hepatotoxicity-induced rats treated with the methanol root extract are shown in Figures 1–6, Sections from the normal control (Figure 1) displayed normal hepatic cords and portal triads. The negative control (Figure 2) showed increased inflammatory cell infiltration with apoptotic bodies in the portal triad. The positive control (Figure 3) exhibited hepatocytes with enlarged cytoplasmic spaces and a ballooning appearance, together with diffuse portal-triad degeneration and necrosis. Livers from the 100 and 200 mg/kg extract groups (Figures 4 and 5) showed only moderate inflammatory change in the hepatic cord, with normal portal triads and focal nuclear duplication indicative of regenerative activity, while the 400 mg/kg group (Figure 6) showed a moderate number of Kupffer cells alongside portal-triad apoptotic bodies and mild hepatic-cord atrophy.

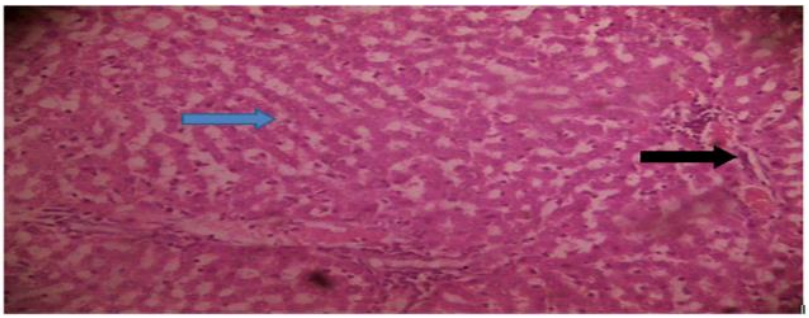

Figure 1: Photomicrograph of liver from the normal control group, showing normal hepatic cords (blue arrow) and a normal portal triad (black arrow)

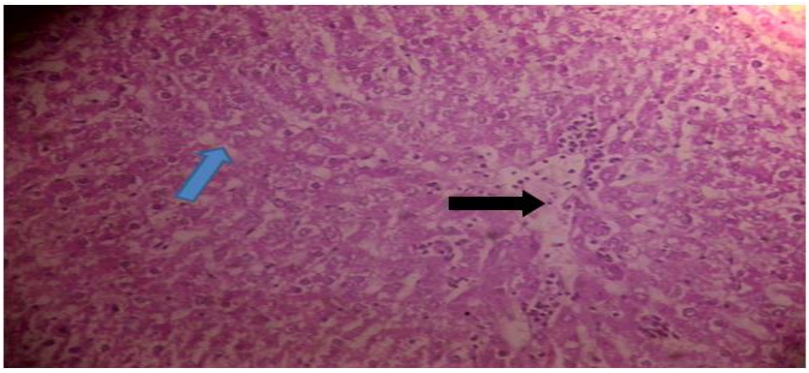

Figure 2: Photomicrograph of liver from the negative control group, showing increased inflammatory cell infiltration (blue arrow) and apoptotic bodies within the portal triad (black arrow).

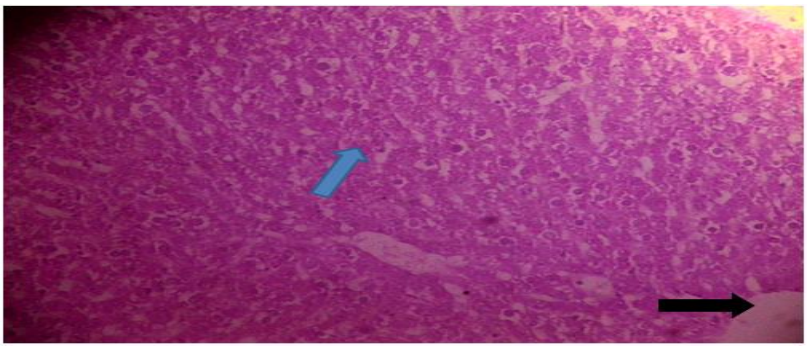

Figure 3: Photomicrograph of liver from the positive control group, showing hepatocytes with enlarged cytoplasmic spaces and a ballooning appearance (blue arrow), with diffuse portal-triad degeneration and necrosis (black arrow)

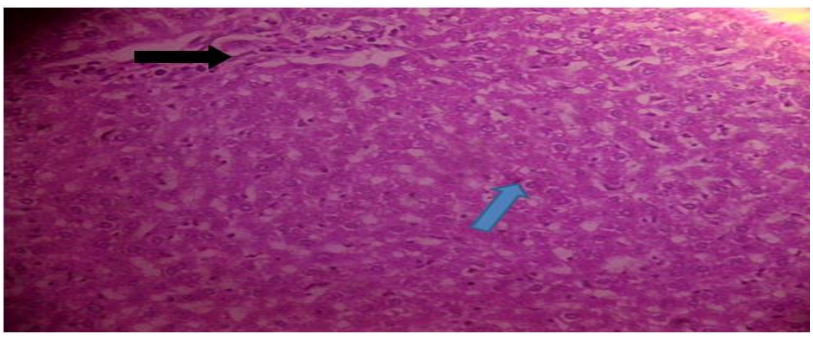

Figure 4: Photomicrograph of liver from the group administered 100 mg/kg extract, showing moderate inflammatory change in the hepatic cord (blue arrow), with a normal portal triad and focal nuclear duplication indicative of regenerative activity (black arrow).

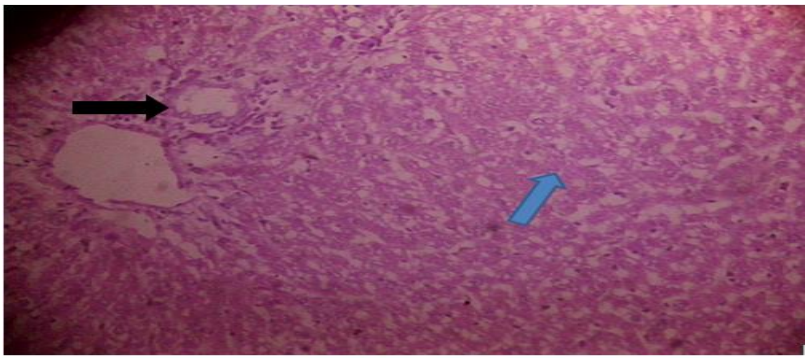

Figure 5: Photomicrograph of liver from the group administered 200 mg/kg extract, showing moderate inflammatory change in the hepatic cord (blue arrow), with a normal portal triad and focal nuclear duplication indicative of regenerative activity (black arrow).

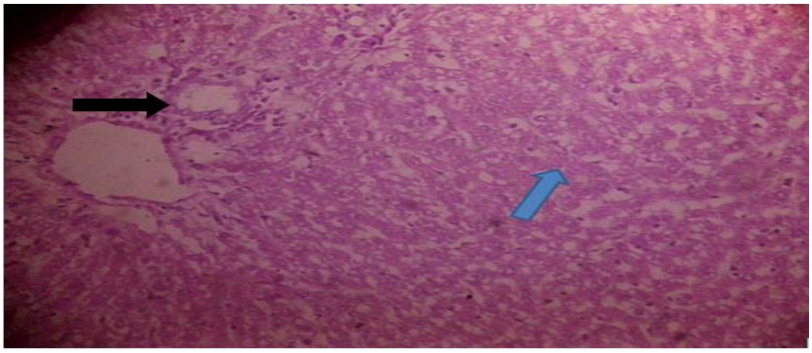

Figure 6: Photomicrograph of liver from the group administered 400 mg/kg extract, showing a moderate number of Kupffer cells (blue arrow), with portal-triad apoptotic bodies and mild hepatic-cord atrophy (black arrow).

Discussion

Research on medicinal plants and traditional healing practices confirms that plants harbour numerous bioactive compounds with therapeutic potential (Patil *et al.*, 2021), and the several secondary metabolites identified in *C. planchonii* likely underlie its hepatoprotective activity. This study examined the extent to which a methanol root extract of *C. planchonii* could protect Wistar rats against paracetamol-induced liver damage. Paracetamol is an analgesic and antipyretic that becomes hepatotoxic at high doses, and for this reason, it is routinely used experimentally to model drug-induced liver injury (Kumar *et al.*, 2022).

The methanol extract of *C. planchonii* root examined here contained alkaloids, steroids, flavonoids, saponins, tannins, and cardiac glycosides, a profile broadly similar to that reported for other hepatoprotective plants (Ojo *et al.*, 2021).

Each of these constituents has some documented relevance to liver protection, although the strength of evidence differs across compound classes. Flavonoids are among the better-studied groups, with antioxidant and anti-inflammatory actions thought to limit genetic damage and lower cancer risk (Abdullahi *et al.*, 2021). Saponins have been linked to enhanced immune function and are already exploited as vaccine adjuvants (Chaudhary and Rani, 2022), while steroids are associated with bone-marrow activity, muscle development, and skeletal strength (Adepoju *et al.*, 2020). Alkaloids show a wider and less uniform range of pharmacological effects, spanning central nervous system stimulation, local anaesthesia, analgesia, and antipyresis (Ibrahim *et al.*, 2021), and cardiac glycosides have a long history of use in managing heart failure and other cardiac conditions (Okeke *et al.*, 2022). The tannin content of the extract is also notable, given that tannins are associated with antifungal, antidiarrhoeal, antioxidant, antihaemorrhoidal, and wound-healing properties, consistent with the traditional use of tannin-rich plants in ulcer treatment (Abubakar *et al.*, 2020).

The absence of mortality at the highest tested dose (5000 mg/kg) in the acute toxicity study indicates a wide margin of safety for the extract, consistent with the toxicity classification proposed by Lorke (2021).

Biochemically, AST was significantly raised in the negative control and in the lower-dose extract groups (100 and 200 mg/kg) relative to the normal control, whereas the 400 mg/kg extract group and the silymarin-treated positive control showed no significant difference from the normal control, pointing to a dose-dependent hepatoprotective effect. ALT and ALP did not differ significantly among the treated groups, and albumin and total protein were largely unaffected except for modest increases in the positive control and the low-dose extract group. Total bilirubin rose significantly only in the low-dose extract group, while direct bilirubin remained unchanged in the higher-dose groups. Collectively, these results suggest that the methanol root extract of *C. planchonii* attenuates paracetamol-induced hepatocellular injury, with the protective effect most evident at the higher doses tested (Patil *et al.*, 2021; Kumar *et al.*, 2022).

These biochemical findings were corroborated histologically: extract-treated livers retained architecture comparable to that of silymarin-treated animals, reinforcing the hepatoprotective potential of *C. planchonii* and aligning with previous reports of liver protection by flavonoid- and saponin-rich plant extracts in experimental models (Ojo *et al.*, 2021; Chaudhary and Rani, 2022).

CONCLUSION

These findings demonstrate that the methanol root extract of *Cochlospermum planchonii* possesses hepatoprotective potential, with the 400 mg/kg dose producing the most pronounced reduction in elevated liver enzyme levels. The results provide scientific support for the traditional use of *C. planchonii* in managing liver-related and other conditions, and underscore the value of continued investigation into this and similarly under-studied medicinal plants as potential sources of solutions to prevailing clinical problems.

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