



Original Research Article

TOXICOLOGICAL EVALUATION OF METHANOLIC STEM BARK EXTRACT OF *Securidaca longipedunculata* IN ALBINO RATS

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ABSTRACT

This study investigated the acute and sub-chronic toxicological effects of the methanolic stem bark extract of *Securidaca longipedunculata* in albino rats in order to evaluate its safety profile. In the sub-chronic study, rats were administered oral doses of 150, 300, and 600 mg/kg body weight of the extract daily for 21 days, while the control group received distilled water. Hematological, biochemical, and histopathological parameters were assessed using standard laboratory procedures. No mortality or obvious signs of toxicity were observed across all treatment groups. Hematological findings showed increases in white blood cell count, lymphocyte percentage, and platelet count, which may suggest a stimulatory effect on the immune system. Serum biochemical analysis revealed that electrolyte levels and renal function indices (urea and creatinine) remained within normal physiological limits. Although alanine aminotransferase (ALT) and aspartate aminotransferase (AST) showed slight increases with increasing dose, the values were still within acceptable reference ranges. A reduction in blood glucose levels was observed in treated groups, indicating a possible hypoglycemic effect of the extract. Histopathological examination showed mild hepatic alterations at higher doses, while kidney and cardiac tissues maintained normal architecture. Overall, the findings from this study suggest that the extract exhibits low toxicity at the tested doses. However, prolonged exposure at higher concentrations may result in mild hepatic stress. Further studies are recommended to isolate the bioactive constituents and clarify their mechanisms of action.

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INTRODUCTION

The use of medicinal plants remains an important component of healthcare delivery in many developing countries, where access to conventional medical facilities is often limited. In such settings, herbal remedies are widely utilized for the management of various diseases due to their availability, affordability, and long-standing cultural acceptance. Although these remedies are widely used, many medicinal plants are consumed without adequate scientific evaluation of their safety, which raises concerns about potential toxic effects

associated with prolonged or excessive use. *Securidaca longipedunculata* Fresen, a member of the family Polygalaceae, is a well-known medicinal plant distributed across tropical Africa. It is commonly referred to as the "violet tree" and has been extensively used in traditional medicine for the treatment of diverse ailments, including fever, pain, inflammation, microbial infections, and neurological and disorders. Different parts of the plant, such as the roots, stem bark, and leaves, are employed in ethnomedicinal practice

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Previous phytochemical investigations have revealed the presence of biologically active compounds such as flavonoids, saponins, alkaloids, tannins, and terpenoids, which are associated with various pharmacological activities. However, alongside its therapeutic benefits, there have been reports suggesting that *Securidaca longipedunculata* may exert toxic effects, particularly when administered at high doses or over extended periods. The liver and kidneys, which play essential roles in the metabolism and excretion of xenobiotics, are especially vulnerable to damage from plant-derived compounds. Therefore, it is necessary to evaluate both the beneficial and adverse effects of this plant to ensure its safe use.

Toxicological studies, including acute and sub-chronic assessments, provide valuable information on the safety profile of medicinal substances. Acute toxicity studies help estimate the median lethal dose (LD₅₀), while sub-chronic studies evaluate the effects of repeated exposure on physiological and biochemical parameters, as well as tissue integrity. These evaluations are essential for identifying potential target organs of toxicity and establishing safe dosage ranges. In view of the increasing use of *Securidaca longipedunculata* in traditional medicine, this study was designed to assess the acute and sub-chronic toxicological effects of its methanolic stem bark extract in albino rats, with particular emphasis on hematological, biochemical, and histopathological parameters.

MATERIAL AND METHODS

Plant Collection and Identification

Fresh stem bark of *Securidaca longipedunculata* was collected from Anchan village, Ikara Local Government Area, Kaduna State, Nigeria. The plant was identified and authenticated by a botanist in the Department of Plant Biology, Faculty of Natural Sciences, Bayero University, Kano. A voucher specimen (BUKHAN 0013) was deposited in the herbarium for future reference.

Preparation of Methanolic Extract

The stem bark was shade-dried, pulverized into fine powder, and macerated in 99% methanol for 72 hours. The filtrate was concentrated under reduced pressure at 40°C using a rotary evaporator and stored at 4°C until use.

Experimental Animals

Twenty-four healthy adult albino rats (120–180 g) were obtained from the animal house of the Department of Pharmacology, Bayero University, Kano. The animals were maintained under standard laboratory conditions (25 ± 2°C; 12-hour light/dark cycle) and fed standard pellet diet with water provided ad libitum.

Experimental Design

The animals were randomly divided into four groups (n = 6 per group):

- Group I: 600 mg/kg extract
- Group II: 300 mg/kg extract
- Group III: 150 mg/kg extract
- Group IV: Control (distilled water)

The extract was administered orally once daily for 21 days. Animals were observed daily for signs of toxicity and mortality.

Hematological and Biochemical Analyses

Blood samples were collected via cardiac puncture. Hematological parameters, including White Blood Cells (WBC), Lymphocytes (LYM), Granulocytes (GRN), Red Blood Cells (RBC), Hemoglobin (HGB), Hematocrit (HCT), and Platelets (PLT) were analyzed using an automated hematology analyzer. Serum biochemical parameters including sodium (Na⁺), potassium (K⁺), chloride (Cl⁻), urea, creatinine, alanine aminotransferase (ALT), aspartate aminotransferase (AST), albumin, total protein, and glucose were determined using standard diagnostic kits (Randox Laboratories, United Kingdom).

Histopathological Examination

Liver, kidney, and heart tissues were excised, fixed in 10% formalin, processed, and sectioned at 5 µm thickness. Sections were stained with hematoxylin and eosin and examined under a light microscope at ×400 magnification.

Statistical Analysis

Data were expressed as mean ± standard deviation and analyzed using one-way analysis of variance (ANOVA) followed by Duncan's multiple range test using SPSS version 26.0. A value of P < 0.05 was considered statistically significant.

RESULTS

Administration of graded oral doses of methanolic stem bark extract of *Securidaca longipedunculata* produced no signs of toxicity or mortality in rats at doses up to 1600 mg/kg body weight (Table 1). However, mortality was observed at 2900 mg/kg and 5000 mg/kg. Using

the geometric mean formula ($LD_{50} = \sqrt{D_0 \times D_{100}}$), where D_0 is the highest non-lethal dose (1600 mg/kg) and D_{100} is the lowest lethal dose (2900 mg/kg), the

median lethal dose (LD_{50}) was calculated as 2154.1 mg/kg body weight.

Table 1: Acute Lethal Effects of Methanolic Stem Bark Extract Doses of *Securidaca longipedunculata* Administered Orally to White Albino Rats on Mortality

Group	Dose (mg/kg) body weight	Death
First phase		
1	Distilled water (control)	0/3
2.	10	0/3
3.	100	0/3
4.	1000	0/3
Second phase		
1.	1600	0/1
2.	2900	1/1
3.	5000	1/1

This result examines how different doses of methanolic stem bark extract influence the weight of albino rats over three weeks, comparing treated groups to a control group that received distilled water (DW) as in (Figure 1). The weight changes serve as a proxy for overall health and potential toxic effects of the extract.

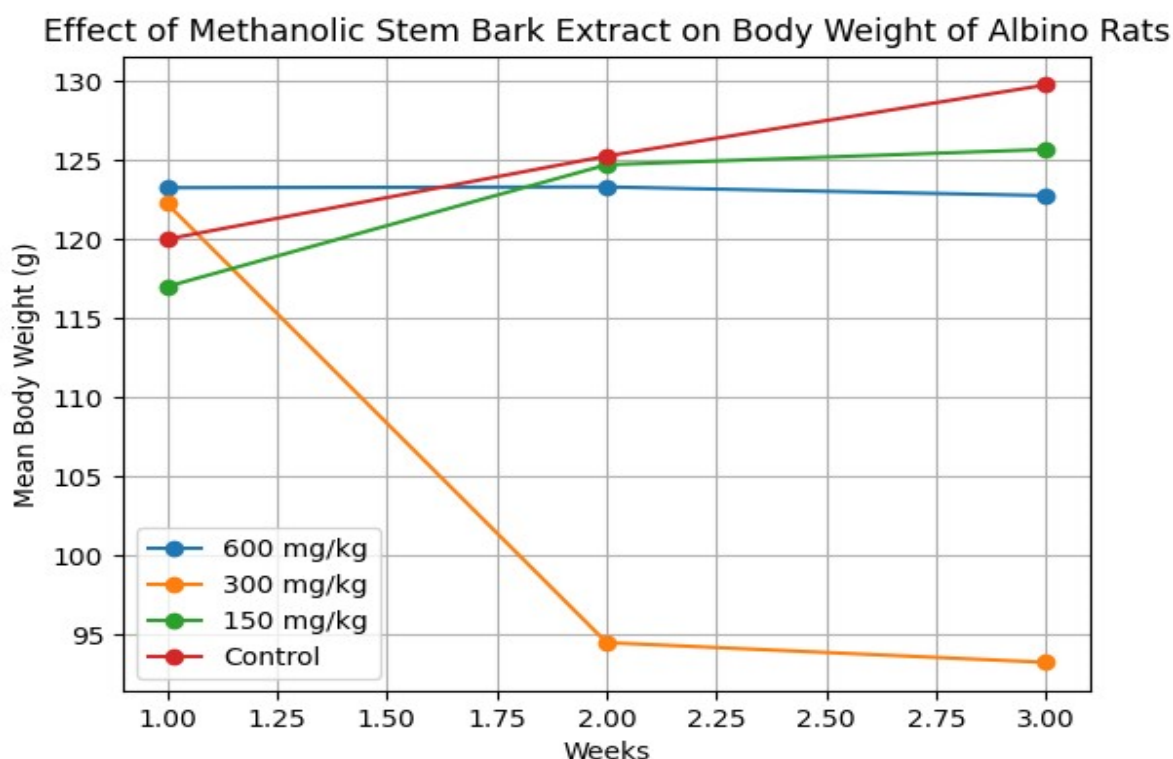


Figure 1: Effects of Methanolic Stem Bark Extract of *Securidaca longipedunculata* on Body Weight of Albino Rats During a 21-Day Sub-chronic Toxicity Study

Administration of methanolic stem bark extract of *Securidaca longipedunculata* produced dose-dependent alterations in the hematological parameters of albino rats (Table 2). White blood cell (WBC) counts increased significantly at 300 mg/kg ($13.04 \times 10^9/L$) compared with the control ($5.81 \times 10^9/L$), exceeding the normal physiological range ($4.0\text{--}10.0 \times 10^9/L$).

Lymphocyte percentages (LYM%) also increased across all treated groups (63.25–67.8%) relative to the control (47.2%), while granulocyte (GRN%) levels decreased from 55.93% in control to 23.0–27.38% in treated groups. Red blood cell (RBC) counts and hemoglobin (HGB) concentrations showed moderate fluctuations, with the highest values recorded at 150 mg/kg ($6.17 \times 10^{12}/L$ and 12.73 g/dL, respectively).

Table 2: Effects Of Methanolic leaf Extract of *S longipedunculata* on Heamatological Parameters of Groups of Albino Rats in 21 days sub chronic toxicity study

Parameters	Extract concentration (mg/kg)				Reference range
	1000	500	250	Control	
WBC ($\times 10^9/L$)	14.01	7.75	7.7	5.81	4.0 - 10.0
LYM (%)	70.1	59.55	66.65	47.2	20 -50.0
GRN (%)	21.38	28.95	26.25	55.93	40.0 -70.0
RBC ($\times 10^{12}/L$)	6.34	5.48	6.38	5.38	3.8 -5.8
HGB (g/dl)	11.53	12.23	12.68	10.97	11.0 -16.5
HCT (%)	35.4	39.53	52.73	35.87	35.0 -50.0
PLT ($\times 10^9/L$)	611.25	628.75	657.23	585	500 – 1500

Key: WBC – White Blood Cells; LYM – Lymphocytes; GRN – Granulocytes; RBC – Red Blood Cells; HGB – Hemoglobin; HCT – Hematocrit; PLT – Platelets.

P > 0.05 (not statistically significant).

Administration of methanolic leaf extract of *Securidaca longipedunculata* produced mild, dose-related variations in the serum biochemical parameters of albino rats (Table 3 and 4). Serum sodium (Na^+) levels ranged from 131.93 to 144.43 mmol/L across the treated groups, remaining within the physiological

range (135–145 mmol/L). Potassium (K^+) and chloride (Cl^-) concentrations also remained largely within normal limits, suggesting that electrolyte balance and renal tubular function were not adversely affected by the extract.

Table 3: Effects of Methanolic Stem Bark Extract of *Securidaca longipedunculata* on Electrolytes and Kidney Parameters of Groups of Albino Rats

Parameters	Extract Concentration (Mg/Kg)				Reference Range
	600	300	150	Control	
Na mmol/l	139.63	137.71	142.57	142.53	135 -145
K mmol/l	5.21	5.21	5	4.2	3.8 - 6.11
CL mmol/l	97.85	98.85	97.58	98.58	98 -106
Urea mmol/l	5.53	5.8	5.55	5.66	4.32 - 8.97
Creatinine μ mol/l	33.92	37.1	33.34	34.45	32.36 - 47.90

P > 0.05 (not statistically significant).

Reference ranges were obtained from standard laboratory values for albino rats.

The effects of the methanolic stem bark extract of *Securidaca longipedunculata* on liver function

parameters revealed dose-dependent alterations in some biochemical indices (Table 4). Alanine

aminotransferase (ALT) levels were markedly elevated at the highest dose (600 mg/kg: 202.48 μ /L) compared to the control (27.83 μ /L) and exceeded the reference range (24–172 μ /L). Aspartate aminotransferase (AST) levels across all groups were within the wide reference range (0.2–838.30 μ /L), showing no significant alteration. Albumin (ALB) concentrations in all treated groups (70.68, 64.54, and 65.33 g/L) were

above the stated reference range (26.8–34.55 g/L). Total protein (TP) levels were markedly reduced in the treated groups (22.15–25.41 g/L) compared to the control (60.84 g/L) and below the reference range (56.05–76.0 g/L). Blood glucose levels were elevated in all treated groups (136.4–140.87 mg/dL) relative to the control (101.88 mg/dL).

Table 4: Effects of Methanolic Stem Bark Extract of *Securidaca longipedunculata* on Liver Function Parameters of Groups of Albino Rats

Parameters	Extract Concentration (Mg/Kg)				
	600	300	150	Control	Reference Range
ALT μ /l	202.48	193.20	132.47	27.83	24 – 172
AST μ /l	31.8	39.51	31.66	32.58	0.2 - 838.30
ALB g/l	70.68	64.54	65.33	65.59	26.8 -34.55
TP g/l	22.22	25.41	22.15	60.84	56.05 -76.0
Glucose mg/dl	140.87	139.51	136.4	101.88	50.0 -135

Key: AST – Aspartate aminotransferase, ALB – Albumin, TP – Total protein, ALT – Alanine aminotransferase

Histological evaluation was conducted to assess the potential tissue toxicity of methanolic stem bark extract of *Securidaca longipedunculata* on the liver, kidney, and heart of albino rats after 21 days of oral

administration (Plate i). The results were interpreted based on tissue architecture, cellular integrity, and the presence of degenerative or inflammatory changes.

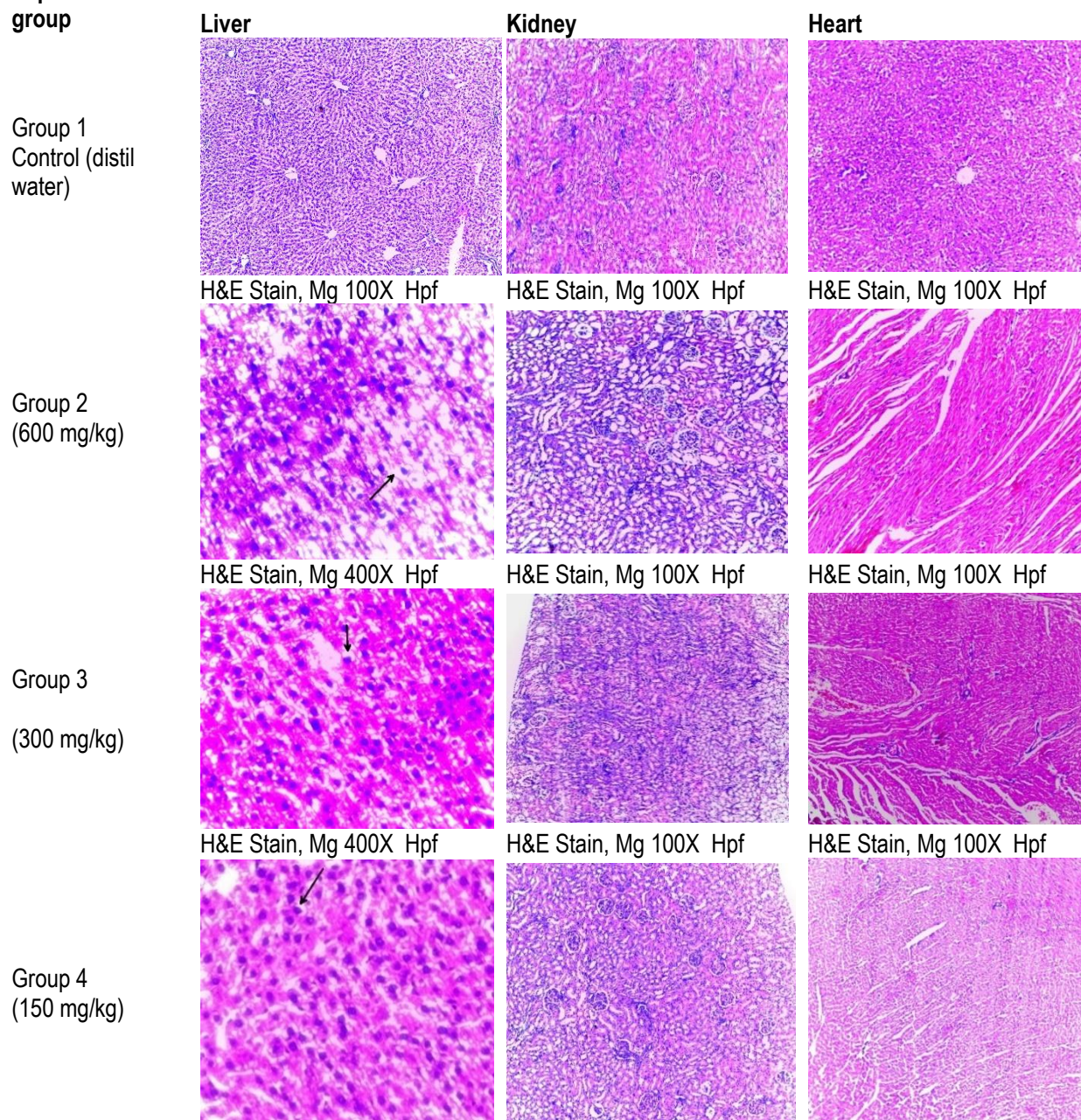
Experimental group

Plate 1: Clinical Effects of Methanolic Stem Bark Extract of *S longipedunculata* on Architecture of the Liver, Kidney and Heart of Groups of Albino Rats in 21 days sub chronic

DISCUSSION

The findings from this study provide important insights into the toxicological profile of the methanolic stem bark extract of *Securidaca longipedunculata*. The calculated median lethal dose (LD_{50}) of 2154.1 mg/kg body weight suggests that the extract has relatively low

acute toxicity when administered orally. This observation is consistent with earlier reports indicating that extracts of *Securidaca longipedunculata*, particularly those obtained using organic solvents, are generally well tolerated at moderate doses [10, 23].

However, variations in reported LD₅₀ values across studies may be attributed to differences in extraction methods, plant parts used, geographical sources, and experimental models, all of which influence phytochemical composition and biological activity [21, 22].

The absence of mortality and observable signs of toxicity during the sub-chronic study further supports the relative safety of the extract at the tested doses. Body weight is a sensitive indicator of systemic toxicity, and the absence of consistent weight loss suggests that the extract did not adversely affect normal growth or metabolic processes. Similar findings have been reported in studies involving medicinal plant extracts where no significant changes in body weight were observed following sub-chronic administration [3, 4]. Hematological parameters are useful indicators of physiological and pathological changes in response to xenobiotic exposure. The increase in white blood cell count, particularly at the intermediate dose, may indicate stimulation of the immune system. This finding is in agreement with previous reports that demonstrated immunomodulatory effects of *Securidaca longipedunculata* and other medicinal plants rich in flavonoids and saponins [1, 5]. The elevated lymphocyte levels observed in this study further support a possible enhancement of adaptive immune responses, which has also been reported in similar studies [3].

The reduction in granulocyte percentage observed across treated groups may reflect a relative shift in leukocyte distribution rather than a direct suppression of granulocyte production. Comparable hematological changes have been documented in plant-based toxicity studies where bioactive compounds influence leukocyte differentiation and immune balance [6].

Red blood cell indices, including RBC count, hemoglobin concentration, and hematocrit values, showed only mild variations across groups, suggesting that the extract did not significantly impair erythropoiesis or oxygen transport. The slight increase observed at lower doses may be associated with the antioxidant properties of phytochemicals, which help stabilize erythrocyte membranes and reduce oxidative damage [6, 26].

The increase in platelet count observed in treated groups may indicate stimulation of thrombopoiesis or a physiological response to mild systemic stress. Similar findings have been reported in studies evaluating the hematological effects of plant extracts, where elevated

platelet levels were associated with enhanced hematopoietic activity [2].

Biochemical parameters assessed in this study provide insight into the functional status of vital organs. The serum levels of urea and creatinine remained within normal ranges across all groups, suggesting that renal function was not significantly affected. These findings are consistent with previous studies that reported no evidence of nephrotoxicity following administration of *Securidaca longipedunculata* extracts [5, 10].

Liver enzymes, particularly alanine aminotransferase (ALT) and aspartate aminotransferase (AST), showed mild elevations in treated groups. However, these increases remained within physiological limits, suggesting that they may be associated with adaptive hepatic metabolism rather than overt hepatocellular damage. Similar observations have been reported in studies where mild enzyme elevations were linked to increased metabolic activity in response to phytochemical exposure [3, 21].

Serum albumin and total protein levels did not show consistent patterns of impairment across all groups, indicating that hepatic synthetic function was largely preserved. However, the variations observed may reflect physiological responses to the extract and should be interpreted with caution.

The reduction in blood glucose levels observed in treated animals suggests a potential hypoglycemic effect of the extract. This finding is consistent with previous reports demonstrating the glucose-lowering activity of *Securidaca longipedunculata* and other medicinal plants containing bioactive compounds such as flavonoids and saponins [17, 4].

Histopathological evaluation revealed mild hepatic alterations at higher doses, including cytoplasmic vacuolation and inflammatory cell infiltration. These findings suggest that the liver may be a target organ at higher exposure levels. Similar dose-dependent hepatic changes have been reported in sub-chronic toxicity studies of medicinal plant extracts [3, 11]. In contrast, the preservation of normal renal and cardiac architecture indicates that the extract did not induce structural damage in these organs within the duration of the study, which aligns with previous findings [5].

Taken together, the results of this study indicate that the methanolic stem bark extract of *Securidaca longipedunculata* is generally well tolerated at the tested dose levels. However, the mild hepatic changes observed at higher doses suggest that caution may be necessary, particularly with prolonged use. This

highlights the importance of dose regulation when considering the therapeutic application of this plant.

CONCLUSION

The findings of this study demonstrate that the methanolic stem bark extract of *Securidaca longipedunculata* possesses relatively low acute toxicity, with no mortality observed at doses up to 1600 mg/kg. Sub-chronic administration over 21 days did not produce marked adverse effects on hematological, biochemical, or histopathological parameters, except for mild hepatic alterations at higher doses.

These results suggest that the extract is relatively safe at low to moderate doses and support its continued use in traditional medicine. However, the observed hepatic changes at higher concentrations indicate the need for caution during prolonged use. Further studies are recommended to investigate long-term toxicity, isolate active constituents, and evaluate pharmacokinetic properties for safe therapeutic application.

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AUTHORS' CONTRIBUTION

NAS: Designed and carried out the Lab work, analyzed data and drafted the manuscript. Prof. MDM and Prof. UAD: Designed, supervised the work, and proofread the manuscript.

CONFLICT OF INTEREST

There were no possible conflicts of interest during the research process.

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