

Toxicological Evaluation of *Dracaena trifasciata* Methanolic Extract on Liver Function in Wistar Rats

S. I. Davies

PAMO University of Medical Sciences

D. C. Nwachukwu

cnwachukwu@pums.edu.ng

PAMO University of Medical Sciences

H. D. Kagbo

University of Port Harcourt

Research Article

Keywords: *Dracaena trifasciata*, Hepatotoxicity, Liver enzymes, Sub-acute toxicity, Wistar rats, Phytotherapy

Posted Date: July 23rd, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10436444/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Background

Dracaena trifasciata is a widely used ornamental and medicinal plant with reported antibacterial and anti-inflammatory properties. Despite its extensive ethnomedicinal application, scientific validation of its safety profile—particularly with respect to hepatic toxicity—remains limited. This study evaluated the acute and sub-acute toxicological effects of *D. trifasciata* methanolic leaf extract on liver function in Wistar rats.

Methods

Acute oral toxicity was evaluated using a limit dose of 2000 mg/kg body weight according to OECD Guideline 423. For the sub-acute study, Wistar rats received daily oral doses of 250, 500, or 1000 mg/kg of the extract for 28 consecutive days in accordance with OECD Guideline 407. Serum biochemical markers of liver function (ALT, AST, ALP, bilirubin, total protein, and albumin) and histopathological changes in liver tissue were assessed.

Results

Acute toxicity testing revealed no mortality or observable adverse clinical signs at oral doses up to 2000 mg/kg. In the 28-day sub-acute study, the 250 mg/kg dose produced no significant alterations in liver biochemical markers or histology. However, higher doses (500 and 1000 mg/kg) resulted in significant ($p < 0.05$) elevations in serum ALT and AST, alongside significant reductions in total protein and albumin levels. Histopathological analysis confirmed dose-dependent hepatic injury at 500 and 1000 mg/kg, characterized by sinusoidal dilation, cellular degeneration, hepatocellular necrosis, and inflammatory cell infiltration.

Conclusions

Dracaena trifasciata methanolic extract is relatively safe at low doses (≤ 250 mg/kg), but prolonged exposure to higher concentrations (500 mg/kg and above) poses significant hepatotoxic risks. Caution and regulated dosing are recommended for its traditional therapeutic use.

Background

Dracaena trifasciata (Prain) Mabb. (synonym *Sansevieria trifasciata*), commonly referred to as snake plant or mother-in-law's tongue, is a perennial succulent indigenous to tropical West Africa and is now widely cultivated globally as both an ornamental and medicinal plant. In traditional West African and

global ethnomedicinal practices, various parts of the plant are utilized to manage jaundice, respiratory inflammatory conditions, skin infections, and ulcerative lesions [1].

These traditional claims have stimulated scientific interest in the plant's pharmacological properties. Phytochemical investigations have revealed that *D. trifasciata* contains a diverse range of bioactive constituents, including flavonoids, saponins, alkaloids, tannins, and terpenoids, which contribute to its documented antioxidant, antimicrobial, and anti-inflammatory activities [2, 3].

Despite its therapeutic application, the safety profile of *D. trifasciata* preparations has not been fully established. While herbal medicines are widely perceived as natural and inherently safe, accumulating clinical and experimental evidence indicates that plant-derived compounds can exert toxic effects when administered at high doses or over prolonged periods [4].

Because the liver is the primary organ responsible for xenobiotic metabolism and detoxification, it is highly susceptible to phytotoxin-induced injury. Hepatotoxicity commonly manifests as elevated serum liver enzymes, impaired protein synthesis, and structural alterations such as hepatocellular necrosis and inflammatory infiltration [4].

Methanol is frequently employed as an extraction solvent due to its effectiveness in solubilizing a broad spectrum of secondary metabolites; however, methanolic extracts may also concentrate potentially hepatotoxic constituents. Consequently, a systematic toxicological evaluation of the methanolic extract of *D. trifasciata* is essential to define safe dosage ranges and support its rational therapeutic application.

Methods

Plant Material and Extraction

Fresh leaves of *Dracaena trifasciata* were collected, authenticated, dried, and pulverized. Extraction was carried out using methanol as a polar solvent to yield the crude methanolic extract. The extract was concentrated under reduced pressure and stored at 4°C until use.

Experimental Animals

Healthy adult Wistar rats (150–200 g) of both sexes were sourced and acclimated to standard laboratory conditions (25 ± 2°C, 12-hour light/dark cycle) with free access to standard rodent pellet diet and water *ad libitum*.

Acute Toxicity Study

Acute oral toxicity was determined in female Wistar rats following the OECD Guideline 423 (Acute Toxic Class Method) [5]. A single limit dose of 2000 mg/kg body weight of the extract was administered orally

to a treatment group (n = 6). Animals were monitored closely for the first 4 hours, and daily thereafter for 14 days, for mortality, behavioral changes, and clinical signs of toxicity.

Sub-acute Toxicity Study

Repeated-dose 28-day oral toxicity was conducted in accordance with OECD Guideline 407 [6]. Rats were randomly divided into four groups (n = 6 per group) and treated daily via oral gavage for 28 consecutive days as follows:

1. **Group I (Control)**: Received distilled water (10 mL/kg).
2. **Group II (Low Dose)**: Received *D. trifasciata* extract (250 mg/kg).
3. **Group III (Medium Dose)**: Received *D. trifasciata* extract (500 mg/kg).
4. **Group IV (High Dose)**: Received *D. trifasciata* extract (1000 mg/kg).

Sample Collection and Biochemical Analysis

On Day 29, following an overnight fast, animals were anesthetized and sacrificed. Blood was collected via cardiac puncture into plain tubes, allowed to clot, and centrifuged at 3000 rpm for 10 minutes to obtain serum.

Serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total bilirubin, total protein, and albumin were quantified using standard spectrophotometric diagnostic kits.

Histopathological Examination

Immediately after blood collection, the liver of each animal was excised, weighed, and inspected macroscopically. Tissue slices were fixed in 10% neutral buffered formalin, dehydrated in ascending grades of alcohol, cleared in xylene, and embedded in paraffin wax. Sections of 5\ \mum thickness were cut, stained with hematoxylin and eosin (H&E), and examined under a light microscope for pathological alterations.

Statistical Analysis

Data are expressed as Mean $\pm$ Standard Error of the Mean (SEM). Statistical comparison between groups was performed using One-Way Analysis of Variance (ANOVA) followed by Dunnett's post-hoc test. Value variations of $p < 0.05$ were considered statistically significant.

Results

Acute Toxicity Study

No mortality, behavioral changes, or physical signs of toxicity were observed in the rats during the 14-day observation period following a single oral administration of 2000 mg/kg body weight of *D. trifasciata* methanolic extract (Table 1).

Table 1
Acute Oral Toxicity of *Dracaena trifasciata* Methanolic Extract in Wistar Rats

Group	Dose (mg/kg)	Mortality	Observed Toxic Signs
Control Group	0	0/6	None observed
Treated Group	2000	0/6	None observed

Sub-acute Toxicity (Serum Biochemistry)

Daily oral administration of the extract for 28 days resulted in dose-dependent alterations in liver function markers. No significant biochemical changes were observed in the 250 mg/kg group. However, the 500 mg/kg and 1000 mg/kg groups showed significant ($p < 0.05$) elevations in serum AST and ALT levels compared to the control group (Table 2).

Table 2
Effect of *Dracaena trifasciata* Methanolic Extract on Serum Liver Enzymes

Group	Dose (mg/kg)	AST (U/L)	ALT (U/L)
Control	0	27.00 ± 0.58	Within normal range
Low dose	250	No significant change	No significant change
Medium dose	500	Elevated*	Elevated*
High dose	1000	34.33 ± 1.45*	Elevated*

*Note: Significantly different from control ($p < 0.05$).

A significant decrease ($p < 0.05$) in synthetic markers—total protein and albumin—was observed in the groups receiving 500 mg/kg and 1000 mg/kg of the extract (Table 3), indicating compromised hepatic synthetic capacity at these doses.

Table 3
Effect of *Dracaena trifasciata* Methanolic Extract on Hepatic Synthetic Function

Group	Dose (mg/kg)	Total Protein	Albumin
Control	0	Normal	Normal
Low dose	250	No significant change	No significant change
Medium dose	500	Decreased*	Decreased*
High dose	1000	Decreased*	Decreased*

*Note: Significantly different from control ($p < 0.05$).

Histopathological Findings

Histological analysis of liver sections confirmed the biochemical patterns. Normal liver architecture was observed in control and low-dose groups, whereas structural damage was apparent in the higher-dose groups (Table 4).

Table 4
Histopathological Changes in Liver Tissue Following Sub-acute Exposure

Group	Dose (mg/kg)	Histopathological Findings
Control	0	Normal hepatic architecture with intact hepatocytes and central veins
Low dose	250	Normal hepatocyte cords, clear sinusoids, and intact central veins
Medium dose	500	Prominent sinusoidal dilation, cellular degeneration, mild inflammatory changes
High dose	1000	Extensive hepatocellular necrosis, marked sinusoidal congestion, inflammatory infiltration

Discussion

The toxicological evaluation of herbal extracts in animal models is a crucial prerequisite to establishing safety margins for human use. This study assessed the acute and sub-acute toxicity of the methanolic leaf extract of *Dracaena trifasciata* to evaluate its safety profile on liver function in Wistar rats.

The absence of mortality or visible clinical abnormalities at a single limit dose of 2000 mg/kg indicates that the extract possesses low acute toxicity and has a wide safety margin under short-term exposure, which aligns with previous general findings on the genus [1, 5].

However, repeated oral administration over 28 days revealed dose-dependent hepatotoxic effects at higher doses (500 and 1000 mg/kg). Significant elevations in serum ALT and AST in these groups suggest compromised hepatocellular membrane integrity, causing these cytosolic enzymes to leak into systemic circulation. ALT and AST are sensitive, well-established biomarkers of acute or chronic liver injury [7, 8]. The absence of significant changes in these enzymes at 250 mg/kg implies that lower doses are well-tolerated by the liver.

Furthermore, the significant reductions in total protein and albumin levels in the 500 and 1000 mg/kg treatment groups indicate compromised hepatic synthetic function. Because albumin is synthesized exclusively by functional hepatocytes, a decline in its serum level is directly associated with chronic liver damage or impaired synthetic capacity [8].

These biochemical alterations were strongly corroborated by histopathological observations. Liver sections from the 250 mg/kg group showed intact architecture identical to the control group. Conversely, the 500 and 1000 mg/kg groups showed pathological changes including sinusoidal dilation, cellular degeneration, inflammatory infiltration, and localized necrosis. These structural changes are typical features of herb-induced hepatotoxicity [9].

The safety observed at the 250 mg/kg dose might be mediated by the antioxidant properties of flavonoids and phenolic compounds present in the extract, which scavenge free radicals and stabilize membranes [3]. Conversely, at elevated doses, concentrated phytoconstituents—specifically saponins and alkaloids—may trigger cytotoxic pathways, disrupt cellular membranes, and induce oxidative stress beyond the metabolic capacity of the hepatocyte organelle network [10].

Additionally, the use of methanol as an extraction solvent facilitates the concentration of polar bioactive elements, both therapeutic and toxic. This highlights the need for careful dose titration in therapeutic applications. Ultimately, these results align with the growing body of pharmacological evidence showing that natural herbal preparations can carry hepatotoxic risks if used excessively or without standardized dosing protocols [11].

Conclusion

The methanolic leaf extract of *Dracaena trifasciata* is relatively safe at low doses (≤ 250 mg/kg), but daily administration of higher doses (500 and 1000 mg/kg) over 28 days induces significant hepatotoxicity. Caution and standardized dose regulations are strongly recommended for its medicinal applications.

Declarations

Ethics approval and consent to participate: All animal experiments were approved by the Research Ethics Committee of University of Port Harcourt and were conducted in strict accordance with the internationally accepted principles for laboratory animal use and care (OECD Guidelines).

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions:

- **Davies, S.I:** Coordination, data collection tracking, literature documentation, and organizational support.
- **Nwachukwu D.C.:** Data and statistical analysis, data field entry, manuscript revisions.
- **Kagbo H.D.:** Conceptualization, Methodological optimization, Institutional quality control checks, validation of analytical metrics, and final critique

All authors read and approved the final manuscript.

Acknowledgements: The authors acknowledge the technical support provided by the Department of Pharmacology and Toxicology staff at the University of Port Harcourt.

References

1. Babu K, Prabhu DS. *Dracaena trifasciata* (Prain) Mabb.: Traditional uses, phytochemistry, and pharmacological activities—A comprehensive review. *J Phytopharmacol*. 2024;13(3):235–41.
2. Dewatisari WF, To'bungan N. Ethnopharmacology and phytochemical profile of *Dracaena trifasciata*. *Nusantara Biosci*. 2024;16(2):169–84. 10.13057/nusbiosci/n160205.
3. Kannan P, Jayakrishnan A. Phytochemical characterization and therapeutic applications of *Dracaena trifasciata*: Implications for pharmaceutical development. *Int J Minor Fruits Med Aromat Plants*. 2025;11(1):132–50.
4. Teschke R, Frenzel C, Schulze J, Eickhoff A, Danan G. Herb-induced liver injury: Challenges and pitfalls of causality assessment. *Methods Mol Biol*. 2013;987:555–94. 10.1007/978-1-62703-321-3_27.
5. OECD. Test No. 423: Acute oral toxicity—Acute toxic class method. Paris: OECD Publishing; 2002.
6. OECD. Test No. 407: Repeated dose 28-day oral toxicity study in rodents. Paris: OECD Publishing; 2008.
7. Ozer J, Ratner M, Shaw M, Bailey W, Schomaker S. The current state of serum biomarkers of hepatotoxicity. *Toxicology*. 2008;245(3):194–205. 10.1016/j.tox.2007.11.021.
8. Giannini EG, Testa R, Savarino V. Liver enzyme alteration: A guide for clinicians. *CMAJ*. 2005;172(3):367–79. 10.1503/cmaj.1040752.
9. Andrade RJ, Chalasani N, Björnsson ES, Suzuki A, Kullak-Ublick GA, Watkins PB, et al. Drug-induced liver injury. *Nat Rev Dis Primers*. 2019;5(1):58. 10.1038/s41572-019-0105-0.
10. Wang Y, Tang C, Zhang H, Zhang L. Toxicological mechanisms of alkaloids and saponins: Implications for herbal medicine safety. *Front Pharmacol*. 2019;10:1469. 10.3389/fphar.2019.01469.
11. Teschke R, Danan G. Worldwide use of herbal products and the risk of hepatotoxicity. *Liver Int*. 2021;41(3):483–96. 10.1111/liv.14700.