

**Ethnomedicinal Significance, Pharmacognostic Characterization And
Phytopharmacological Potential Of Cordia Macleodii Hook.F. & Thomson: A
Comprehensive Review With Special Reference To Alcohol-Associated Liver**

Injury: Review Article

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Abstract

Background. *Cordia macleodii* Hook.f. & Thomson (Boraginaceae) is an ethnomedicinally important deciduous tree of the Indian dry deciduous forests, traditionally used for wound healing, jaundice and inflammatory conditions. Pharmacognostic studies of leaf and stem bark have established diagnostic macroscopic, microscopic and physicochemical characters useful for authentication [1,2], and experimental work has demonstrated antioxidant, hepatoprotective, antimicrobial and wound-healing activity [3,4].

Objective. To integrate the available evidence on the taxonomy, ethnobotany, pharmacognosy, phytochemistry and pharmacology of the species, with particular attention to its traditional association with alcohol-related effects and the strength of evidence supporting that association.

Methods. Published pharmacognostic, phytochemical and pharmacological investigations and comprehensive reviews were critically appraised and organised under botanical identity, pharmacognosy, phytochemistry, pharmacology, safety, conservation and research gaps.

Results. Preliminary screening has demonstrated alkaloids, glycosides, tannins, flavonoids, phenolics, saponins and terpenoids [1,2,5]. Ethanolic leaf extract showed concentration-dependent antioxidant activity in four in-vitro models and hepatoprotective activity against carbon tetrachloride-induced liver injury in rats [3]. Leaf preparations showed moderate activity against some Gram-positive organisms and model-dependent wound-healing effects [4]. Anti-inflammatory, antihypertensive, antivenom and antidepressant activities have also been reported [5]. Direct evidence in alcohol-induced experimental models is absent.

Conclusion. *C. macleodii* is a promising but underexplored species. Traditional use and preclinical activity should not be equated with clinical efficacy; standardized extracts, validated chemical fingerprints, alcohol-specific models, mechanistic studies, toxicology and controlled clinical trials are required.

Keywords: *Cordia macleodii*; Boraginaceae; pharmacognosy; ethnobotany; phytochemistry; hepatoprotective; antioxidant; alcohol-associated liver injury.

1. Introduction

Medicinal plants remain an important source of therapeutic leads, and ethnobotanical information provides a rational starting point for pharmacological enquiry — provided that traditional use is supported by reproducible botanical authentication and controlled experiment.

Cordia macleodii Hook.f. & Thomson is an ethnomedicinally important member of the Boraginaceae reported from several regions of India and used by indigenous communities for wound healing, jaundice, mouth sores and inflammatory conditions [1,2,5]. The leaf was characterised pharmacognostically by Bhide et al. [1], and the stem bark subsequently by microscopy, preliminary screening and TLC/HPTLC profiling [2]. Ethanolic leaf extract showed antioxidant and hepatoprotective activity [3]; leaf extracts were also evaluated for antimicrobial and wound-healing effects [4]. A 2024 review synthesised the taxonomy, ethnobotany, pharmacognosy, phytochemistry, pharmacology and conservation status of the species [5].

Of particular interest is the traditional association of the plant with alcohol-related effects. Because alcohol exposure produces oxidative stress, inflammation and hepatic injury, this association is pharmacologically plausible — but an ethnomedicinal claim must be distinguished from experimentally demonstrated activity and, more strictly, from clinical efficacy. The present review integrates the available evidence and identifies the gaps that must be closed before therapeutic claims can be made.

2. Botanical Identity, Distribution and Vernacular Names

Accepted name: *Cordia macleodii* Hook.f. & Thomson; family Boraginaceae; genus *Cordia*. Author-citation variants occur in the literature, including *C. macleodii* Hook. and *C. macleodii* (Griff.) Hook.f. & Thomson, the latter used in the 2024 review [5]. For publication, nomenclature should be verified against the current accepted botanical database and against the authenticated herbarium voucher used in the study.

The species is reported principally from India and is associated with dry deciduous forest habitat, with earlier pharmacognostic literature recording its occurrence in Odisha, Chhattisgarh and Madhya Pradesh [1]; the 2024 review discusses its conservation concern [5]. Distribution matters pharmacognostically because soil, rainfall, temperature, season and plant age influence both anatomical characters and secondary-metabolite profiles. Future studies should therefore record geographical location, altitude, soil type where relevant, season of collection, plant age and maturity, plant part, and voucher specimen number.

Regional names include Dahiman, Dahipalash, Panki and Shikari [1,5]. Ethnomedicinal use is concentrated in tribal and rural communities, with leaves and bark applied in wound management and in the traditional treatment of jaundice [1,2]. Such observations are valuable leads but require systematic validation, since traditional preparations vary widely in plant part, dose, route, duration and method of preparation.

3. Pharmacognostic Evaluation

Pharmacognosy provides the first level of quality assurance for plant material, since substitution or adulteration compromises both efficacy and safety. A complete evaluation comprises macroscopy, organoleptic evaluation, microscopy, powder microscopy, histochemistry, physicochemical parameters, preliminary phytochemical screening, chromatographic fingerprinting and quantitative standardization.



Figure 1. Habit of the mature tree in forest.



Figure 2. Leaf morphology.

3.1 Leaf

Bhide et al. documented the macroscopic and microscopic characters of the leaf together with preliminary physicochemical and phytochemical parameters, explicitly because prior pharmacognostic information was scarce [1]. Diagnostic macroscopic parameters include shape, size, colour, surface, margin, apex, base, venation, petiole, texture, fracture, odour and taste; microscopy adds characters of the epidermis, mesophyll and vascular bundles. Preliminary screening of the leaf demonstrated alkaloids, glycosides and tannins [1].

Because closely related species may overlap macroscopically, microscopic authentication should form an essential component of crude-drug identification rather than an optional adjunct.

3.2 Stem bark

The stem bark was examined in greater detail in a subsequent study [2]. Microscopy demonstrated cork, cortex, medullary rays, sclerenchymatous fibres, phloem, cambium and crystals. Preliminary screening again demonstrated alkaloids, glycosides and tannins, while TLC and HPTLC profiling produced characteristic spots at 254 and 366 nm, giving a preliminary chemical fingerprint of the bark [2].

3.3 Powder microscopy, histochemistry and physicochemical standards

Where the drug is marketed in powdered form, powder microscopy is the principal identity test: epidermal fragments, trichomes, stomatal structures, parenchyma, vascular fragments, fibres, crystals, starch-bearing cells and lignified elements should all be recorded, supported by histochemical demonstration of lignin, starch, tannins, lipids and calcium oxalate.

Physicochemical evaluation should cover foreign matter, loss on drying, total ash, acid-insoluble ash, water-soluble ash, alcohol- and water-soluble extractives, pH and crude fibre. Values must derive from authenticated, representative samples; specifications built on a single collection cannot define a robust standard. Material should preferably be drawn from several geographical locations and seasons before limits are proposed.

4. Phytochemistry and Chromatographic Standardization

Reported constituent classes include alkaloids, glycosides, tannins, flavonoids, phenolic compounds, saponins, terpenoids, steroids, fixed oils and phytosterols [1,2,5]. The comprehensive review summarised phytochemicals reported from bark, stem and leaf, identifying flavonoids, glycosides, saponins, phenols, terpenoids and fixed oils among the principal groups [5].

Such screening is preliminary by nature: demonstrating a chemical class establishes neither its concentration, nor its bioavailability, nor its therapeutic relevance. The TLC/HPTLC profiles of the bark [2] represent the first step beyond qualitative screening and can serve as identity and batch-consistency markers. Future work should extend to HPTLC fingerprinting, HPLC-DAD, LC-MS/MS, GC-MS for volatile constituents and NMR-based metabolomics, with quantitative marker assays developed under validated analytical conditions.

5. Pharmacological Activities

5.1 Antioxidant activity

Qureshi et al. examined an ethanolic leaf extract in four in-vitro systems — DPPH radical scavenging, nitric oxide radical scavenging, iron chelation and reducing power — and reported concentration-dependent activity in each [3]. This provides a plausible basis for investigating the plant in oxidative-stress-associated disorders, although in-vitro radical scavenging cannot by itself establish antioxidant efficacy in vivo, still less in humans.

5.2 Hepatoprotective activity

In the same investigation, carbon tetrachloride administration to rats raised GPT, GOT, ALP and total bilirubin; pretreatment with the extract at 100, 200 and 400 mg/kg inhibited these changes, with effects reported as comparable to silymarin 100 mg/kg under the conditions employed [3]. This is the strongest single experimental finding for the species.

It is essential to note that this was a CCl₄ -induced hepatotoxicity model, not an alcohol-induced liver injury model. The result therefore cannot be read as direct evidence that *C. macleodii* prevents or treats alcoholic liver disease.

5.3 Antimicrobial activity

Leaf preparations were evaluated by agar-disc diffusion against bacterial, yeast and fungal strains, showing moderate sensitivity in some Gram-positive bacteria and no activity against the Gram-negative organisms tested [4]. Comparison across studies must account for extraction solvent, concentration, strain selection, assay conditions and controls. The activity observed may contribute to the traditional use of the plant in wound management, though clinical efficacy remains unestablished.

5.4 Wound healing

Excision, incision and dead-space models in Wistar rats were used to assess wound closure, epithelialization, tensile strength and histopathology [4]. The findings indicated limited, model-dependent effects — weak tensile-strength promotion and effects on neovascularization and ground-substance formation — without a clear effect on excision wound contraction [4]. Reporting this result with its limitations, rather than generalising it, is precisely what distinguishes a critical review from a promotional one.

5.5 Anti-inflammatory and other reported activities

The wider literature reports anti-inflammatory, antihypertensive, antivenom and antidepressant activity [5]. Anti-inflammatory potential is of particular interest because inflammation underlies wound healing and hepatic injury alike, yet the molecular targets and the constituents responsible remain poorly defined. Future work should address cyclooxygenase and lipoxygenase pathways, NF- κ B signalling and TNF- α , IL-1 β and IL-6 production. Because crude-extract activity may reflect several constituents acting individually or synergistically, isolation work should be accompanied by parallel evaluation of crude extract, fraction, isolated compound and standardized combination.

Table 1. Summary of current evidence and its level for *Cordia macleodii*.

Domain	Current evidence	Level of evidence
Botanical identity	Documented; author citation varies	Established
Leaf pharmacognosy	Macroscopy, microscopy, physicochemical [1]	Experimental
Stem-bark pharmacognosy	Microscopy, TLC/HPTLC, screening [2]	Experimental
Phytochemistry	Multiple metabolite classes [1,2,5]	Preliminary
Antioxidant	Four in-vitro assays [3]	Preclinical
Hepatoprotective	CCl ₄ -induced liver injury, rat [3]	Preclinical
Antimicrobial	Disc diffusion; Gram-positive only [4]	Preclinical
Wound healing	Animal models; model-dependent [4]	Preclinical
Anti-inflammatory / antihypertensive / antivenom	Reported in review literature [5]	Preliminary

Alcohol-related traditional use	Ethnomedicinal observation	Hypothesis-generating
Alcohol-induced liver injury	No direct model data	Major research gap
Alcohol-use disorder	Insufficient evidence	Not established
Clinical efficacy	Insufficient evidence	Not established

6. Relevance to Alcohol-Associated Disorders

Alcohol consumption produces a spectrum of effects involving oxidative stress, inflammation, hepatic dysfunction and metabolic disturbance, and the ethnomedicinal literature on the species offers an interesting entry point. The evidence must nevertheless be kept in three distinct tiers. Traditional use (Level I) is an ethnopharmacological observation and a source of hypotheses. Experimental antioxidant and hepatoprotective activity (Level II) has been demonstrated [3]. Clinical evidence in alcohol-use disorder or alcohol-related liver disease (Level III) is at present insufficient. Conflating these tiers is the commonest failure in ethnopharmacological reviews.

Because alcohol metabolism generates reactive oxygen species, it is reasonable to ask whether standardized extracts modulate alcohol-associated oxidative stress, using malondialdehyde, reduced glutathione, superoxide dismutase, catalase, glutathione peroxidase and total antioxidant capacity as endpoints. This would be substantially stronger evidence than extrapolation from generic radical-scavenging assays.

Equally, different hepatotoxic models represent different mechanisms, so the CCl₄ result [3] justifies — but does not substitute for — work in chronic ethanol-induced liver injury, alcohol-associated steatosis, hepatic lipid accumulation and CYP2E1-related pathways.

A further distinction is essential: antioxidant or hepatoprotective activity must not be equated with treatment of alcohol dependence. A plant may protect hepatic tissue from toxic injury without affecting craving, dependence or withdrawal. Future research should therefore separate (i) protection against alcohol-induced oxidative stress, (ii) hepatoprotection, (iii) modulation of alcohol metabolism, (iv) reduction of alcohol consumption, (v) reduction of withdrawal symptoms and (vi) treatment of alcohol-use disorder — six distinct objectives requiring six distinct experimental designs.

6.1 A proposed experimental design

A logical development pathway runs from authenticated material through standardized extract and chemical fingerprint, to in-vitro antioxidant and anti-inflammatory evaluation, an alcohol-induced cellular injury model, a chronic alcohol exposure animal model with biochemical, oxidative-stress and histopathological endpoints, mechanistic pathway investigation, toxicology, pharmacokinetics and finally clinical evaluation. Table 2 sets out a concrete animal design for the key gap.

Table 2. Proposed rodent design for alcohol-associated liver injury.

Group	Treatment	Endpoints
I	Normal control	Body and liver weight; ALT, AST, ALP, bilirubin
II	Alcohol-exposed control	Triglycerides, total cholesterol
III	Alcohol + low-dose standardized extract	MDA, reduced glutathione, SOD, catalase
IV	Alcohol + medium-dose standardized	TNF- α , IL-1 β , IL-6

	extract	
V	Alcohol + high-dose standardized extract	Hepatic histopathology; steatosis grading
VI	Alcohol + established hepatoprotective comparator	CYP2E1 expression where feasible

7. Safety, Toxicology and Quality Control

The presence of pharmacologically active constituents does not establish safety. Before clinical development, acute single-dose toxicity should define approximate safe exposure; 28- and 90-day repeated-dose studies should cover haematological and biochemical parameters, renal and hepatic function and histopathology; genotoxicity assays are appropriate where long-term use is proposed; and reproductive toxicity testing is required where chronic use or use in reproductive-age populations is contemplated. Potential interactions with hepatic enzyme systems, anticoagulants, antihypertensives, antidiabetic agents and CNS-active medicines should be assessed explicitly, particularly given the reported antihypertensive activity.

Table 3. Proposed quality-control framework for a standardized monograph.

Quality parameter	Proposed approach
Botanical identity	Authenticated herbarium voucher
Macroscopy / microscopy	Diagnostic morphological and anatomical characters
Powder microscopy	Diagnostic fragments
Foreign matter; moisture	Quantitative determination; loss on drying
Total and acid-insoluble ash	Gravimetric determination
Extractive values	Water- and alcohol-soluble extractives
Phytochemical profile	Preliminary qualitative screening
Chromatographic fingerprint	HPTLC / HPLC
Marker compounds	Validated quantitative method
Microbial quality	Pharmacopoeial method
Heavy metals; aflatoxins	Validated instrumental / analytical methods
Pesticide residues; residual solvents	Validated methods, where applicable

8. Conservation

The comprehensive review identifies conservation concern for the species and stresses propagation and sustainable use [5]. Pharmacological development should therefore proceed alongside authenticated nursery propagation, seed conservation, controlled harvesting and cultivation protocols, maintenance of genetic diversity and community participation. Where bark is the traditional drug, sustainable collection is critical, since excessive removal can damage or kill mature trees — a pharmacological success story that destroys its own raw material is no success at all.

9. Research Gaps and Future Perspectives

- Taxonomic standardization: author-citation variants should be resolved against the current accepted database in all future publications.
- Pharmacognostic datasets: existing studies rest on limited sampling; multi-location, multi-season data are needed before specifications are set.
- Validated markers: no marker-based quantitative quality-control system yet exists for the species.
- Mechanistic evidence: most reported activities lack molecular characterisation and constituent attribution.

- Alcohol-specific evidence: the central gap — general antioxidant and CCl₄ hepatoprotective data cannot substitute for alcohol-induced models.
- Clinical evidence: no controlled human trials support therapeutic claims.
- Safety data: long-term toxicity and herb–drug interaction data are absent.

The field should move from descriptive pharmacognosy toward integrated, evidence-based pharmacognosy: botanical authentication, pharmacognostic and physicochemical standardization, HPTLC/HPLC fingerprinting, LC-MS/MS metabolomic profiling, isolation of marker constituents, in-vitro mechanistic work, validated animal models, toxicology, pharmacokinetics and clinical evaluation.

10. Conclusion

Cordia macleodii Hook.f. & Thomson is an ethnomedicinally significant tree with a documented history of traditional use across several Indian states. Pharmacognostic study of leaf and stem bark has established characters suitable for authentication and preliminary quality assessment [1,2], and phytochemical screening has demonstrated several classes of secondary metabolites [1,2,5]. Experimental work supports antioxidant and hepatoprotective activity of the ethanolic leaf extract [3], with antimicrobial and model-dependent wound-healing effects also reported [4], alongside anti-inflammatory, antihypertensive and antivenom activity in the wider literature [5].

The traditional association with alcohol-related effects is an interesting ethnopharmacological lead, but it is not clinical proof of efficacy in alcohol-use disorder or alcohol-related liver disease; notably, the available hepatoprotective study used a CCl₄ model rather than an alcohol model [3]. The defensible conclusion is that *C. macleodii* possesses promising preliminary antioxidant and hepatoprotective properties that justify specific investigation in alcohol-associated experimental systems. Authenticated and standardized material, validated fingerprints, identified bioactive markers, alcohol-specific models, mechanistic work, pharmacokinetics, toxicology and well-designed clinical trials are the steps that would bridge traditional knowledge and modern pharmacology without overstating what is currently known.

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