

Current Review on Ethnopharmacological Approach on Medicinal Value of *Cordia macleodii* as a Traditional Herb of Importance

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Abstract

Background: The medicinal properties of plants and plant derivatives have led to their long-term use in medicine.

Objectives: The present review article was drafted to discuss the traditional importance of *Cordia macleodii* and its different therapeutic uses.

Methodology: The following keywords were used to search the online databases: *C. macleodii*, ethnopharmacological approach, traditional applications, medicinal herb; Scopus, Web of Science, and PubMed. Consequently, this review set out to compile a narrative review on phytochemistry and the recent advancement of the targeted plant species.

Results: This article covers the following topics: toxicity, ethnobotanical and medicinal uses, potential biological activity and applications, phytochemical components, and geographical sources. There are several bioactive components in *C. macleodii*, and different parts make it a powerful herbal medicinal plant. These include terpenoids, glycosides, phenols, tannins, saponins, steroids, volatile oils, amino acids, alkaloids, and resins. The botanical description of the plant was discussed, including macroscopic and microscopic characters. Although little is known, *C. macleodii* may offer health and therapeutic benefits. It has several beneficial effects, including reducing inflammation and pain, protecting the liver, speeding wound healing, lowering blood pressure, and protecting against oxidative stress.

Conclusion: This comprehensive review screens all valuable parts' primary chemical ingredients and their pharmacological activity to help pharma companies develop new medicine formulations.

Keywords

Healing, anti-inflammatory, ethnobotanical, *Cordia macleodii*, alkaloids, flavonoids, anti-venom

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Introduction

Plants provide the majority of the resources and are responsible for the fulfillment of many of humanity's most fundamental needs. Several ancient cultures, including the Chinese, the Indians, the Romans, and the Greeks, attest to the efficacy of plants and natural items as medicines (Salmerón-Manzano et al., 2020). Indian pharmaceutical companies and traditional Indian medical systems like Ayurveda, Siddha, and Unani rely heavily on natural remedies and medicinal plants (Ahmad et al., 2022; Jaiswal & Williams, 2016).

Out of India's 4.5 million plant species, an estimated 2.5–5 million have been screened for their phytochemical content and biological activity. A growing number of pharmaceutical companies are exploring the possibilities of herbal medicine and its biologically active components as supplementary methods to illness treatment and the development of novel

herbal formulations (Khan et al., 2020; Nasim et al., 2022; Singh et al., 2022). A group of plants and shrubs known collectively as *Cordia* are found primarily in warmer climates. As many as 13 species of the genus *Cordia* can be found in India, out of a total of roughly 300 species known worldwide (Pausas & Lamont, 2022; Williams et al., 2023).

Cordia macleodii belongs to the family Boraginaceae. Shikhari, Dahiman, or Dahipalas is a little tree-like plant that bears only white flowers. The oblong, green leaves have a cordate base and a crenate, dentate border (Dixit & Chandrakar, 2017; Pausas & Lamont, 2022). *C. macleodii* is endemic to

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India, specifically the states of Odisha, Madhya Pradesh, Maharashtra, Chhattisgarh, and Tamil Nadu, all of which feature dry deciduous and moist forest habitats. The tribal people use the plant medicinally for a wide variety of conditions, including wound healing, mouth sore treatment, jaundice treatment, and as an aphrodisiac (Soni & Bodakhe, 2014).

Several pharmacological studies on *C. macleodii* have shown promising results, suggesting that the plant may have anti-inflammatory, anti-bacterial, hepatoprotective, wound-healing, analgesic, and antioxidant properties (Deb et al., 2018). Terpenoids, glycosides, alkaloids, phenols, tannins, saponins, steroids, volatile oils, amino acids, and resins are some of the main and secondary metabolites and compounds found in *C. macleodii* (Ahmed et al., 2019). *C. macleodii* is a significant ethnomedicinal plant in India due to its medicinal characteristics, pharmacological activity, and diverse phyto-compounds (Rizwan et al., 2022; Setyorini & Antarlina, 2022). The purpose of this article is to provide a thorough analysis of the plant *C. macleodii*, including its flora, chemistry, possible biological applications, folkloric and therapeutic uses, and toxicity.

Bioactive chemicals found in plants have improved human health for all recorded history. It is estimated that anywhere from 50,000 to 80,000 plant species, or their pharmacological derivatives, are used in the world's healthcare systems (Ozturk & Hakeem, 2019). The chemical makeup, characterization, and pharmacological examination of plant products are all integral parts of the drug development process. The production of commercially relevant species and their secondary metabolites, including alkaloids, flavonoids, and phytosterols with pharmaceutical potential, has been significantly aided by tissue culture techniques in recent years (Jain et al., 2019). The economic significance of medications derived from plants is quickly expanding, and it is having a beneficial effect on the healthcare system for humans (Bukar et al., 2016). Research into the chemical components and pharmacological effects of medicinal plants has increased in recent years (Kumar & Pandey, 2015; Pandey et al., 2017a, 2017b; Pandey, Singh, et al., 2017; Pandey et al., 2018; Pandey, Patel et al., 2019; Pandey, Sharma et al., 2019). These bioactive chemicals showed great promise as new drug candidates, given their potential efficacy against a wide range of disorders. There are several bioactive components present in *C. macleodii* different parts that make it a powerful herbal medicinal plant. These include terpenoids, glycosides, phenols, tannins, saponins, steroids, volatile oils, amino acids, alkaloids and resins

Phytochemical Constituents

Any plant's potential as a medicine relies heavily on its phytochemical makeup. The researchers reported that *C. macleodii* possesses several phytochemical compounds that are responsible for biological activities (Pandey, Singh,

et al., 2017). There is strong evidence from a literature review of *C. macleodii*'s phytochemical contents that various portions of the plant are rich in various beneficial chemicals (Pandey, Patel et al., 2019). According to a comprehensive review of the available evidence, secondary metabolites of pharmacological significance are most concentrated in tree bark, followed by leaves and the stem (Pandey, 2018a, 2018b).

Chemical Composition of Stem Bark

According to physicochemical analysis, bark comprises a variety of components, including sugar, starch, tannins, hexane-soluble extractive, alcohol-soluble extractive, water-soluble extractive, and acid-insoluble ash. The triterpenoids, acetone, methanol, and reducing sugar found in the hexane and chloroform bark extracts are joined by the saponins, tannins, glycosides, and alkaloids found in the aqueous bark extract (Kumar et al., 2011; Kushwaha et al., 2015). This extract consists of carbohydrates, flavonoids, and resin, in addition to acetone, ethyl alcohol, petroleum ether, and water (Kushwaha et al., 2015). In addition, high-performance thin-layer chromatography (HPTLC) reveals 2.18%, 8.40%, 7.01%, 24.93%, 17.07%, and 5.86% for foreign materials, loss on drying, alcohol-soluble extractive, water soluble extractive, total ash, and acid in soluble ash in powdered stem bark (Kushwaha et al., 2015).

In addition to *p*-hydroxyphenylacetic acid and β -sitosterol, gas chromatography/mass spectrometry (GC/MS) analysis and infrared/ultraviolet (IR/UV) characterization of the unsaponifiable fraction of petrol-ether bark extract revealed the presence of three compounds: stigmasterol, campesterol, and cholest-5-en-3-ol (3 β)-carbonyl chlorinated (Nariya et al., 2014; Nayak & Kalidass, 2016). Researchers have found flavonoids in bark fraction UV spectra (Nayak & Kalidass, 2016), and quercetin in ethanolic (Chaubey et al., 2016; Nayak & Kalidass, 2016) and methanolic bark extracts (Nariya et al., 2017). Methanolic bark extract was also used to isolate the flavonoids apigenin and kaempferol (Nariya et al., 2017). There is hope for removing the hazardous element manganese from wastewater by using granular activated charcoal made from the bark at pH 11.5, 330 min of contact time, 6 mg/L of initial metal concentration, 1.4 g of adsorbent dosage, and 650°C (Wanjari, 2016).

Chemical Composition of Stem

Several bioactive compounds, such as alkaloids, tannins, saponins, phenolics, and phytosterols, are reported to be present in the stem part of *C. macleodii* (Dhal et al., 2014).

Chemical Composition of Leaf

As the leaves dry out, the drug's physicochemical study shows that their moisture content falls, and the extractive

values are soluble in water and alcohol. The qualitative examination of powdered, methanolic, petroleum ether, and water extracts of the leaf revealed the presence of glycosides, alkaloids, flavonoids, tannin, lipids and fixed oils, terpenoids, steroids, phenolic parts, and resin. In the physicochemical analysis of powdered leaf, the following values were found, that is, 2.93% for foreign elements, 5.22% for alcohol soluble extractive, 4.17% for water soluble extractive, 13.68% for total ash, and 3.12% for acid in soluble ash. The HPTLC technique was employed for this investigation. The gallic acid and 3-hydroxy-5-methylbenzoic acid were isolated from the ethanolic leaf extract (Chaubey et al., 2016; Kushwaha et al., 2015). UV-visible (vis) spectroscopy study revealed the presence of phenolics in a purified sample of the leaf. Choloformic leaf extract has been shown to contain beta-carotene using UV-vis and Fourier transform infrared spectroscopy (FTIR) spectroscopy, suggesting its use as a dye-sensitized solar cell (Wanjari et al., 2016).

Botanical Description, Taxonomy, and Geographical Sources

Taxonomic Classification

The taxonomic classification of *C. macleodii* belongs to kingdom—Plantae; phylum—Streptophyta; class—Equisetopsida; subclass—Magnoliidae; order—Boraginales; family—Boraginaceae; genus—*Cordia* and species—*macleodii*.

Common Vernacular Names

C. macleodii is commonly known as Sitapatra, Dahiphalas, Dahiman, Bili challe, Doddacalle, Hadang, Hirichalle, Bhoti, Daiwas, Dhaim, Dhaiwan, Baurlo, Bhoto, Sambarsinga, Panki, Shikari, Palandekku, Botuku, Iriki, Pedda batava and Pedda botuku.

Geographical Sources

The largest genus of the Boraginaceae family, *Cordia*, is primarily a tropical and occasionally subtropical genus. The *C. macleodii* plant is found throughout much of Central India, the Deccan, North Kanara, and the Carnatic. Bihar highlands, Madhya Pradesh, Chhattisgarh, Karnataka, Chota Nagpur, and the Konkan region of India are particularly afflicted (Kumar et al., 2011).

Parts Used

The entire plant can be used to cure a wide range of illnesses. Nevertheless, the leaves, seeds, bark, and stem are the most commonly utilized plant elements (Bhide, Ashok et al., 2011; Bhide, Pillai et al., 2011).

Taxonomic Description of the Plant *C. macleodii*

Leaves are alternate, cordate-ovate, obtuse, 3–5-nerved, permanently tomentose underneath, and seldom sub-opposite. Mature leaves measure 12.5 cm in diameter, while the petiole is 2.5–5 cm. Corolla lobes are oblong and can be as long as 1.6 cm in length. When it is fully ripe, the fruit has a sharply conical shape, and the persisting calyx has a broad funnel or sub-campanulate shape (Bhide, Ashok et al., 2011; Bhide, Pillai et al., 2011; Pandey et al., 2020).

Macroscopic and Microscopic Characters of *C. macleodii*

Macroscopic Characters

Polygamous and deciduous, *C. macleodii* is a small to medium-sized tree or shrub. Its trunk is 45–60 cm in diameter, and it can grow to a height of 10–15 m. The morphology of the plant and other sections is defined below (Bhide, Ashok et al., 2011; Bhide, Pillai et al., 2011; Oza & Kulkarni, 2017; Pandey et al., 2020).

Bark

It has a carrot-red interior and an exterior layer that is pale green when fresh and a grayish brown when dry. As a result of trauma, it produces exudates. Although the bark's exterior is tough, the interior is smooth and white and made of fibrous material. The bark is extremely rough and splinters easily. The bark does not have any distinctive smell or taste.

Leaves

The glossy, dark green leaves of this plant are broadly oval. The underside of the leaf has hairs and has a pale green tint. The size of the leaves, which range from 15–20 cm to 12–18 cm, is obtuse and bluntly acuminate. White cystoliths are abundant in nerves four–six originating from the lower spinal cord. Petioles range in length from 3.8 to 7.5 cm and are alternating in shape.

Flowers

The terminal and axillary tomentose cymes/spikes of these polygamous, subsessile, yellowish/orangey white flowers are thickly paniculated. Male flowers lack a style and stigma but still contain an ovary.

Calyx

It might be shaped like a tube or a cone. It has obtuse lobes that are 8–10 mm long, with four–six small, pointed edges.

Corolla

The infundibuliform shape is a creamy yellow. Hypocrateriform or campanulate lobes (6–10) are found. The lobes are larger than the tube, have an obtuse and veined appearance, and measure 2.0–3.0 mm in size; the length is about 1.5 cm. The ovary has four follicles, and one of the oocytes is standing upright.

Stamens

It is exerted, has a hairy base, and grows in groups of six. Base filaments of stamens can be either hairy or glabrous.

Anthers

In contrast to their hermaphrodite counterparts, male flowers are distinguished by the size of their anthers. Anthers of male flowers are large, and those of hermaphrodite flowers are smaller. Flowers are white and fragrant, five–six lobes and size span of more than 2 cm.

Fruits

The majority of fruits are globe- or ovoid-shaped, with a bony endocarp and a viscous pulp. The drupes sit atop a calyx that is broadly campanulate, toothed or lobed, and ribbed, and they are a yellowish apiculate subglobose shape.

Microscopic Characters

Microscopic characteristics of *C. macleodii* include a discussion of transverse sections of leaves, petioles, and bark (Bhide, Ashok et al., 2011; Bhide, Pillai et al., 2011; Oza & Kulkarni, 2017; Pandey et al., 2020).

Transverse Section of Bark

There are 10–12 corks that are distributed radially and tangentially in the bark cross-section. Phelloderm—parenchymatous stone cells, prismatic calcium oxalate crystals, tannins, and fibers—is in cork cambium. Sieve tubes, companion cells, phloem parenchyma, and tangentially running bands of thick-walled lignified fibers make up primary and secondary phloem, in which diverse medullary rays split and cross.

Transverse Section of Leaf

Under a transverse section, the leaf's midrib is dorsiventral. The cuticle of the epidermis, the skin's outermost layer, is thick and rectangular. Nevertheless, epidermal cells are smaller in the lamina's lower part. Mesophyll is radially elongated, so the narrow palisade cells stand out. Stellate parenchymal tissues also include upper and lower regions of air. A semilunar vascular bundle within a parenchymatous bundle

sheath containing a brownish material may be discerned at the midrib. Phloem patches are bicollateral, meaning they extend from both the xylem and the mesophyll layers. Both epidermis are covered by four or six layers of collenchymas.

Stomata are easily distinguished in young leaves, and in the lamina, they are most numerous on the underside and least numerous on the upper side. Stomata typically take on a ranunculaceous or cruciferous form (anisocytosis and anomocytic). Calcium oxalate crystals can be seen in their crystalline form. Many trichomes, both glandular and non-glandular, populate the top and lower epidermis. Both the base and head of these trichomes are bulbous, indicating that they are unicellular or multicellular and uniseriate. Some of the glandular trichomes have bigger, multicellular crowns on top of unicellular stalks. The midrib is segmented into an upper, middle, and lower section. The lower part is round, the middle has a vascular bundle, and the upper part is raised and has patches of collenchyma.

Transverse Section of the Petiole

An urn-shaped network of glandular and non-glandular trichomes with patches of collenchyma covers the petiole's outer epidermal surface. A small channeled groove runs across the middle of the petiole, and the upper half of the petiole is elevated laterally on either side to accommodate vascular bundles. The bottom, more circular section is the bulk of the structure. Starch grains and bi-collateral phloem patches, both encased in a parenchymatous bundle sheath, can be seen on the xylem's exterior and inner surfaces. Between the vascular bundles and the pith are medullary rays that radiate outward. Calcium oxalate crystals are encased in a dark brownish/reddish material that fills most of the parenchymal cells.

Phytoconstituents of Plant *C. macleodii*

Non-nutritional phytoconstituents contained in plants have significant medicinal potential. The different pharmacological actions of plants can be attributed to these phytoconstituents. Phytochemistry refers to the study of plant compounds and their chemical composition. Initial examinations of several components of the *C. macleodii* plant have uncovered a wide variety of chemical groups, including terpenoids, glycosides, tannins, flavonoids, steroids, phenols, alkaloids, resins, amino acids, and carbohydrates. In Table 1, we see the chemical structures of the isolated chemical constituents from various plant sections (wood, bark, leaves, and flowers).

Application and Pharmacological Activity of *C. macleodii*

C. macleodii's pharmacological potential has been investigated for decades. According to the research, this plant has several medicinal properties, including those that fight germs, reduce inflammation, dull pain, protect the liver, and even work as an anti-venom (Oza & Kulkarni, 2017). Internally or

Table 1. List of Identified Compounds Obtained from Various Parts of *Cordia macleodii*.

Plant Parts	Identified Compound	Chemical Structure	References
Bark		Steroids	
	Stigmasterol		Nariya et al. (2014)
	Cholest-5-en-3ol (3 β)-carbonyl chlorinated		Nariya et al. (2014)
	Campesterol		Nariya et al. (2014)
Leaves and flowers		(A) Flavonoids	
	Quercetin		Alves et al. (2015) and Oza and Kulkarni (2017)
	Kaempferol		Alves et al. (2015) and Oza and Kulkarni (2017)
Leaves and flowers		(B) Phenolic and phenolic acids	
	Ferulic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Caffeic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Chlorogenic acids		Alves et al. (2015) and Oza and Kulkarni (2017)
	<i>p</i> -Hydroxybenzoic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	<i>p</i> -Hydroxyphenyl lactic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
Wood		Fatty acids	
	Arachidic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Linoleic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Lauric acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Myristic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Oleic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Palmitic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Ricinoleic acid		Alves et al. (2015) and Oza and Kulkarni (2017)
	Stearic acid		Alves et al. (2015) and Oza and Kulkarni (2017)

externally, the plant's stem, bark, and leaves—in the form of extracts, powder, or decoction—display a wide range of pharmacological actions.

Antioxidant Activity

C. macleodii plant extract possesses significant antioxidant activity. It has reported free radical scavenging activity in the presence of several phytoconstituents. Similar to flavonoids, this miraculous plant has been proven to provide potent antioxidant activity. Extracts of the leaves of *C. macleodii* were tested for their antioxidant properties utilizing

tried-and-true *in vitro* techniques. Against 2-diphenyl-1-picryl-hydrazyl hydrate (DPPH) and nitric oxide radicals, the *C. macleodii* extracts demonstrated robust radical scavenging and good reduction activity. At a dosage of 800 mg/mL, ethanolic extract from leaves inhibits the formation of DPPH and nitric oxide radicals (Qureshi et al., 2009). *In vivo* studies with an ethanolic extract showed a dose-dependent inhibition of reducing power and iron chelation. Plants interact with the antioxidant enzymes glutathione peroxidase (GPx), superoxide dismutase (SOD), and catalase (CAT) (Qureshi et al., 2009), a ligand having a scavenging effect and a higher influence on antioxidant activity.

The DPPH radical scavenging activity assay, the Folin–Ciocalteu reagents for phenolic content determination, and the Oyaizu procedure for reducing power determination were used *in vitro* to assess the antioxidant activity of *C. macleodii* bark extracts. *C. macleodii* bark extracts had antioxidant activity that was on par with standard ascorbic acid across the board. As evaluated by the inhibition of DPPH and the reduction of power activities, the antioxidant activity of *C. macleodii* extracts was higher than that of ordinary L-ascorbic acid. Total phenols, which control oxidation, were found in high concentrations in bark extracts. Evidence from studies (Nariya et al., 2012) suggests that extracts of the bark of the *C. macleodii* plant can be employed as an easily accessible source of antioxidants.

Anti-hypertensive Properties

It is a condition where there is abnormal pressure in the blood vessels. Among *C. macleodii*'s many therapeutic uses, it acts as a hypertensive. Twenty patients were selected at random and split into two groups; both received the leaf powder twice daily for a month as part of the trial. Both *C. macleodii* leaf powder and Sarpagandha leaf powder were administered to one group (Dikshit & Jaiswal, 2011). Evidence and statistics showed that *C. macleodii* leaf powder lowered blood pressure on both the diastolic and systolic sides. It was also found to control urea levels in the blood.

Anti-microbial Activity

Anti-bacterial activity is higher in *C. macleodii* leaf water extract compared to the gold standard medication ciprofloxacin. The *C. macleodii* extracts were highly effective against the gram-negative bacteria *Bacillus subtilis* and the fungus *Aspergillus niger*. Extracts obtained 12 h after incubation exhibited considerably greater anti-bacterial and anti-fungal activity than those obtained 6 h after incubation.

The methanolic extract of *C. macleodii* bark demonstrated a strong anti-bacterial effect when tested on agar plates using the zone of inhibition technique with multiple standards. The bacteria tested included two gram-negative (*Pseudomonas aeruginosa* and *Escherichia coli*) and two gram-positive (*Staphylococcus aureus* and *Streptococcus pyogenes*) strains. *S. aureus* and *E. coli* showed the greatest degree of growth inhibition among the bacteria tested (Qureshi et al., 2010). *C. macleodii* leaf and stem extracts were tested for their anti-fungal properties using a variety of solvents. The water extract of plant was showing anti-fungal activity against *Aspergillus flavus*, *A. niger*, and *Candida albicans*, more specifically to its leaf and stem parts (Chaubey et al., 2015).

Anti-inflammatory Activity

As a pathophysiological protective tissue response to various stimuli (damaged cells or pathogens), inflammation causes a

local increase in blood cells and plasma fluid and involves immune cells, blood vessels, and particular mediators (Ferrero-Miliani et al., 2007). Many plants have been studied for their possible anti-inflammatory properties and flavonoid content. Research into the anti-inflammatory properties of *C. macleodii* leaf extract on rat paw edema caused by carrageenan has been conducted. An extract from *C. macleodii* leaves considerably reduced paw edema compared to the control group, suggesting that this chemical has strong anti-inflammatory capabilities. Standard Diclofenac diethylamine was shown to suppress edema by 92%, but *C. macleodii* extract only inhibited it by 44%.

Hepatoprotective Activity

Herbal remedies and other all-natural products have been used for centuries to protect against and treat liver disease. Extensive research on their hepatoprotective potentials (Krepkova et al., 2021; Rouf et al., 2021) suggests that the medicinal claims of numerous of these herbal medicines are backed by scientific analysis. The hepatoprotective benefits of *C. macleodii* alcoholic leaf extract were studied by Qureshi et al. (2009) using a carbon tetrachloride-induced liver injury paradigm in rats. Blood enzyme levels of serum glutamate pyruvate transaminase (SGPT), alkaline phosphatase (ALP), serum glutamate oxaloacetate transaminase (SGOT), and total bilirubin were found to be considerably lower in rats pretreated with *C. macleodii* leaf extract (Qureshi et al., 2009).

Anti-venom Activity

Snakebites affect people all around the world and are a major public health concern. Anti-venoms derived from plants have been used to successfully treat snakebites for centuries (Lizarzaburu-Ortiz et al., 2022). A rare medicinal and timber plant, *C. macleodii* has a successful history of treating snakebites (Lakhmale et al., 2012). Soni and Bodakhe (2014) investigated the anti-venom efficacy of an alcohol extract of *C. macleodii* bark in a study involving Najain Wistar rats. *C. macleodii* extract considerably reduced mortality, edema, hemorrhagic lesions, and necrotizing lesions in rats induced by Naja venom at doses of 400 and 800 mg/kg. The bark extract also prevented the venom from defibrinating or coagulating. In addition, isolating frog hearts showed that the extract mitigated its cardiotoxic effects (Soni & Bodakhe, 2014).

Wound Healing Properties

A wound is any disruption in the cellular, structural, and functional integrity of living tissue caused by physical, chemical, or microbiological means. Tissue regeneration and repair are two key components of the wound healing process (Sharma et al., 2021). The impact of *C. macleodii* on wound healing Bhide,

Ashok et al. (2011) and Bhide, Pillai et al. (2011) investigated hook leaf extracts. They investigate the effects of *C. macleodii* on incision, dead space, and excision wounds. Although the extract was shown to have no effect on excision wound contraction, it was found to have a weak tensile strength encouraging activity and to have stimulated new vascular development in incision wounds and dead space wounds. Furthermore, granulation tissue development was reported to be exceptionally low in *C. macleodii*. Fiber content and angiogenesis both increased when contrasted with the control group (Bhide, Ashok et al., 2011; Bhide, Pillai et al., 2011).

Sharma et al. undertook an open, randomized, controlled trial of the wound-healing benefits of ghrita, which is derived from the leaves of *C. macleodii*. *C. macleodii* ghrita and povidone-iodine were randomly administered to 10 patients each. Wounds in the group treated with *C. macleodii* ghrita were significantly smaller than those in the group treated with povidone iodine, indicating that the *C. macleodii* ghrita-based formulation had good wound healing activity (Ashish et al., 2013).

Ethnobotanical Value of *C. macleodii*

Many ethnobotanicals and ethnopharmacological studies have focused on *Cordia* species. Tropical and subtropical areas of the Americas, Asia, and Africa are their primary habitats, although you can find them in several nations across the world. Traditional communities make great use of the several *Cordia* species that are grown for their decorative qualities, wood, and medicinal uses. *Cordia* species have been the subject of a plethora of research in recent decades, with a particular emphasis on their phytochemical, biological, and pharmacological properties. The plant *C. macleodii* Hook is a member of the Boraginaceae family. Many novel pharmacologically efficacious compounds and chemical entities have their origins in plants with ethnomedicinal significance. In its many tribal communities, India has some of the world's most diverse plant life, and the country's rich ethnomedicinal traditions have much to offer the world's sick. The ethnomedicinal plant *C. macleodii* Hook. (Boraginaceae) has been praised for its ability to heal wounds, attract a partner, and preserve the liver. Various phytocompounds, including quercetin, *p*-hydroxyphenylacetic acid, and phytosterols, including β -sitosterol, stigmasterol, campesterol, and cholest-5-en-3-ol (3 β)-carbonyl chlorinated, have been extracted from this plant. The tribal people of Orissa, Chhattisgarh, and Madhya Pradesh seldom see this medium-sized tree, which they call Panki or Shikari.

Traditional Importance of *C. macleodii*

Traditional medical practices have long made use of numerous *Cordia* species to alleviate a wide range of symptoms. The Ayurvedic, Unani, and Siddha medical systems make use of plants like *Cordia dichotoma*, *Cordia latifolia*, *C. macleodii*, *Cordia myxa*, *Cordia rothii*, and *Cordia obliqua*. The

majority of *Cordia* species have multiple medicinal uses, including but not limited to purifying the blood; treating ulcers, boils, tumors, gout, and boils; and finally, reducing fever. The flu, fever, cough, cold, asthma, menstrual cramps, dysentery, diarrhea, headache, and snakebite can all be alleviated with a decoction of the leaves of various species. Traditional medicine practitioners in the Indian states of Odisha, Madhya Pradesh, and Chhattisgarh utilize it to treat a wide range of conditions. Tribal communities in those states have traditionally utilized it for medical purposes. *C. macleodii* is being utilized for a variety of purposes, including wound healing (the leaf and bark of the plant) and mouth sore treatment (the leaf). In addition, the seeds are an aphrodisiac, and the bark is used to treat jaundice (Dubey et al., 2008). An astringent and a liver stimulant, the bark is a useful medicinal herb. Malaria, bronchitis, and tuberculosis are all cured using the root decoction. To alleviate inflammation, wounds, and migraines, a poultice made from the leaves is used topically. The highly mucilaginous fruits of plants belonging to this genus are utilized as a demulcent, a blood purifier, and in the treatment of splenic, kidney, and lung diseases.

Medicinal Uses of *C. macleodii*

C. macleodii has been studied extensively, and the results suggest that it has a number of useful medicinal values, including analgesic and anti-inflammatory effects, as well as anti-microbial and wound-healing capabilities. It also exhibits therapeutically useful qualities such as antioxidant, hepatoprotective, and anti-hypertensive activity. In addition to its analgesic effects, *C. macleodii* Hook affects both the central and peripheral neural systems (Kumar & Elavarasi, 2016; Qureshi et al., 2010).

When the body is inflamed, it exhibits a wide range of biochemical reactions in response to various stimuli from the outside world. It has been shown in studies (Ferrero-Miliani et al., 2007; Qureshi et al., 2010) that *C. macleodii* Hook leaves can demonstrate anti-inflammatory activities. Furthermore, the leaves of *C. macleodii* Hook are powerful anti-fungal agents like *A. niger* and gram-positive bacteria like *B. subtilis*. The bark of the *C. macleodii* Hook tree, on the other hand, contains anti-bacterial properties that can combat both gram-positive and gram-negative bacteria, including *E. coli*, *P. aeruginosa*, *S. pyogenes*, and *S. aureus* (Chaubey et al., 2015; Qureshi et al., 2010).

The leaves of the plant *C. macleodii* Hook exhibit hepatoprotective qualities, suggesting that it may be used to treat and prevent injury to the liver. The antioxidant properties of the leaves and bark of *C. macleodii* Hook have been demonstrated. Wound discomfort, wound discharge, wound size, and wound border all exhibit considerable improvement after treatment with *C. macleodii* Hook leaf extracts, as reported (Bhide, Ashok et al., 2011; Bhide, Pillai et al., 2011). Systolic and diastolic hypertension can both benefit from *C. macleodii* Hook's leaf's anti-hypertensive qualities

(Dikshit & Jaiswal, 2011). Lethality, neurotoxicity, edema, and cardiotoxicity are all decreased by the *C. macleodii* Hook bark, demonstrating its anti-venom capabilities (Soni & Bodakhe, 2014).

Toxicity

A staircase technique was used to conduct an acute toxicity investigation of *C. macleodii* Hook extract. Two mice were given an oral dose of 500 mg/kg individually, then the mice were observed for 24 h. Then, a dose of 1,000 mg/kg was administered to the mice, and at that time, death was recorded. Finally, toxicity and mortality are noted 24 h following the administration of 2,000 mg/kg. Although some animals were reported to experience depression, the findings of the studies showed that *C. macleodii* Hook did not cause death or toxicity even at oral doses as high as 2,000 mg/kg (Ashish et al., 2013).

Future Prospective

The biological and phytochemical evaluation of its many unproven traditional therapeutic activities requires additional research. Biotech research, plant genetic modification, novel drug delivery system creation, and industry partnership are all crucial if we are to reap the commercial benefits of these vital medicinal plants. The global scientific community should investigate its internal composition to produce new treatments to treat chronic diseases and common stressors, including hypertension, cardiac, and neurological disorders. However, accurate identification, nomenclature, raising species population by tissue culture or mother nursery procedures, and global conservation of mother species are the initial steps. By refining extraction techniques and identifying chemical components in leaf and stem extracts, a novel anti-bacterial agent that the public can use could be created (Joshi et al., 2014). Because of the growing demand and interest in phytopharmaceuticals as an alternative treatment for a variety of ailments and in creating new therapeutic agents from natural sources, scientists are revising and increasing their literary knowledge. These bioactive chemicals are a promising new avenue for medication development due to their wide-ranging anti-disease potential. The scientific community throughout the world has a unique obligation to investigate its constituent parts in depth in order to create novel medication formulations for the treatment of chronic diseases and to combat everyday pressures including high blood pressure, heart conditions, and neurological disorders. But the most important thing is to use the right terminology, properly identify species, increase their numbers through methods like tissue culture or mother nursery, and most importantly, protect mother species all over the world. The information reported in this work contributes scientifically to recognizing the importance of *C. macleodii* as a target in the search for new biotechnological investments.

Conclusion

C. macleodii, a threatened species, has bioactive chemicals that make it a valuable medicinal plant. Human civilization's ongoing exploitation of this species for multiple economic applications has wreaked havoc on this valuable taxonomic; thus, it must be preserved for sustainable socio-economic usage. Based on pharmacological screening and clinical testing, the plant *C. macleodii* shows promise as an anti-venom, anti-inflammatory, hepatoprotective, antioxidant, anti-bacterial and anti-fungal, wound healing, anti-hypertensive, and pain reliever—all without serious side effects. There is a need to do scientific research and verify many of the traditional uses of *C. macleodii* because it has been relatively understudied in comparison to other species of *C. macleodii*. This review may help to identify *C. macleodii* as a potential ethnomedicinal plant that could lead to the creation of new medications for a wide range of illnesses.

Abbreviations

ALP: Alkaline phosphatase; CAT: Catalase; DPPH-2: 2-Diphenyl-1-picryl-hydrazyl hydrate; GPx: Glutathione peroxidase; HPTLC: High-performance thin-layer chromatography; IR: Infrared; SGOT: Serum glutamate oxaloacetate transaminase; SGPT: Serum glutamate pyruvate transaminase; SOD: Superoxide dismutase. UV: Ultraviolet.

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