



A ROBUST REVIEW OF THE PHYTOCHEMICAL AND PHARMACOLOGICAL POTENTIAL OF THE NEAR-THREATENED *HALDINA CORDIFOLIA* (ROXB.) RIDSDALE FOR HERBAL DRUG DISCOVERY

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ABSTRACT: *Haldina cordifolia* (syn. *Adina cordifolia*), Haldu or Yellow Teak, is a valuable deciduous tree species recognized for its broad pharmacological and therapeutic potential. The present study compiles and evaluates the phytochemical constituents, traditional uses, and pharmacological properties of *H. cordifolia*, with a focus on its role in drug discovery. Phytochemical investigations have identified a variety of bioactive compounds, including flavonoids, alkaloids, phytosterols, and phenolics such as oleoresins and essential oils. Extracts from the plant, particularly acetone and methanolic fractions, have demonstrated antibacterial, antioxidant, analgesic, hepatoprotective, and antifertility effects in preclinical assays. The evidence presented in this review supports the rationale for further isolation and characterization of therapeutic compounds from *H. cordifolia* to validate its clinical relevance. This review consolidates existing knowledge on the phytochemical constituents and pharmacological activities of *H. cordifolia*, highlighting its potential in modern drug discovery.

Keywords: *Haldina cordifolia*, phytochemistry, pharmacology, traditional medicine, drug discovery

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INTRODUCTION

Medicinal plants have long served as critical resources for treating disease, with nearly 80% of the global population relying on traditional remedies for primary healthcare, according to WHO estimates (Sen and Samanta, 2015). Among the vast number of plant species with ethnomedicinal applications, *Haldina cordifolia*

stands out due to its diverse chemical profile and therapeutic uses. This medium to large deciduous tree, native to the Indian subcontinent and parts of Southeast Asia, has been traditionally employed in managing conditions ranging from gastrointestinal disorders to skin infections and febrile illnesses.

Phytochemicals, including alkaloids, flavonoids, tannins, and terpenoids, are

recognized for their antimicrobial, anti-inflammatory, and antioxidant properties. Investigating such compounds from plants like *H. cordifolia* can lead to the identification of novel agents for combating infectious and chronic diseases.

The most common human use of biodiversity may be medicinal plants, which have been used as unique sources of medicine since ancient times. The World Health Organization (WHO) says that 80 percent of people in developing countries still get their primary health needs from local medicinal plants. There are approximately 550 tribal communities in India, which are divided into 227 ethnic groups. These communities are located in approximately 5000 villages that are situated in a variety of forest and vegetation types (Sen and Samanta, 2015). One of the eight major centers of origin and diversification of domesticated taxa is India, with its glorious past of traditional medicinal systems and plant use patterns. India is one of the twelve megadiversity countries in the world and has a lot of biodiversity. In addition, there is a worldwide agreement regarding the advantages of phytopharmacy and medicinal plants at this time, occupy a crucial position in plant medicine and research. In order to find active medications, phytochemical analysis is required for many species of plants that are widely used as medicines. There aren't yet many plant species with medicinally useful active ingredients. As a result of this fact, we decided to conduct phytochemical research on plants for the study. As raw drugs, extracts are made from a wide variety of medicinal plant parts with a variety of medicinal properties. Leaves, roots, stems, flowers, fruits, twigs, exudates, and altered plant organs are among the various components utilized. Despite the fact that some of these raw drugs were gathered in greater quantities and sold on the market as the raw material for numerous herbal industries. The practice of using medicinal plants or drugs derived from medicinal plants to treat and

cure disease is known as herbal medicine. In contrast to synthetics, which are thought to be harmful to humans and the environment, herbal products today stand for safety. However, herbs were valued for their therapeutic, flavoring, and aromatic properties.

Natural medication is a significant part of all native individuals' conventional medication and a typical component in Ayurvedic, Homeopathic, Unani, Naturopathic, and Conventional Oriental. Plants that belong to the rubiaceae family are used for medicinal purposes and contain secondary metabolites. In the order of flowering plants known as gentianales, the Rubiaceae family is by far the largest. On the gentianales family tree, it is also the oldest branching family. There are approximately 450 genera and 6500 species in the family Rubiaceae, which includes trees and a few thousand herbs 7-10. *Haldina cordifolia* is one of many plants in the Rubiaceae family.

Chaubey *et al.* (2015) identified *Haldina cordifolia* as 'vulnerable' in their study, which compiled a list of threatened and prioritized species conserved according to the standards of IUCN, National Red List, FRLHT, BSI, NPB, and ICFRE. Therefore, it is crucial to prevent this species from further decline toward endangerment. The tree's valuable components, including timber and leaves, have been harvested and traded unsustainably, leading to its classification as 'near threatened' in Madhya Pradesh under the IUCN criteria 3.1 (Khanna *et al.* 2021).

TAXONOMY AND BOTANICAL DESCRIPTION

Class	:	Magnoliopsida
Sub-class	:	Asteridae
Super order	:	Gentiananae
Order	:	Gentianales
Family	:	Rubiaceae
Subfamily	:	Cinchonoideae
Genus	:	Adina

Specific epithet : Cordifolia
Botanical name : Adina cordifolia

Common Names:

Language	Name
Sanskrit	Haridru
Hindi	Haldina
Bengali	Kelikadamba
English	Yellow Teak
Tamil	Manjkadamba

H. cordifolia typically grows up to 35 meters and is widely distributed across India, Sri Lanka, Thailand, and Myanmar. It features large, heart-shaped leaves, yellow globular flowers, and small, tailed seeds enclosed in capsule fruits (Chaubey *et al.* 2015).

HISTORICAL AND TRADITIONAL USE

Historical texts such as the *Atharvaparishishta*, *Paniniya Ashtadhyayi*, and *Raja Nighantu* refer to *H. cordifolia* under various names like Nipa and Pitadaru. It has been utilized in Ayurveda for conditions including jaundice, dysentery, and inflammatory disorders. Traditional healers use the root as an astringent and the bark as a febrifuge, antiseptic, and remedy for skin ailments and rheumatic conditions (Negi *et al.* 2022).

Indigenous to the Indian subcontinent and parts of Southeast Asia, it thrives in tropical deciduous forests and is found across central, eastern, and southern India (Chopra *et al.* 1956; Kirtikar and Basu, 1935).

Ancient Sanskrit literature, including the *Atharvaparishishta*, *Paniniya Ashtadhyayi*, and *Raja Nighantu*, reference this species under names like **Nipa** and **Pitadaru** (Sharma, 1998; Dash, 2003). Over centuries, *H. cordifolia* has been used to treat ailments such as **jaundice, dysentery, fevers, skin conditions, and rheumatic disorders**. Both classical and folk

healing traditions recognize the therapeutic value of its **bark, roots, and leaves** for their astringent, febrifuge, and antiseptic properties (Warrier *et al.* 1995).

REFERENCES IN CLASSICAL TEXTS

ATHARVAPARISHISHTA

The *Atharvaparishishta* mentions **Nipa** in the context of sacred and medicinal plants used in purification and healing rituals (Sharma, 1998). Given its habitat in moist lowlands and riverbanks, Nipa is generally interpreted by Ayurvedic scholars as *Haldina cordifolia*, which thrives in similar ecological zones (Rao, 2005).

PANINIYAASHTADHYAYI

Panini's *Ashtadhyayi* (circa 5th century BCE) is a grammatical treatise that also serves as a record of flora known in ancient India. The reference to **Pitadaru**, describing a yellow-trunked tree, aligns with the yellowish hue of *H. cordifolia* heartwood (Deshpande, 2001). Panini's inclusion of botanical terms signifies the tree's prevalence in ancient Indian landscapes.

RAJA NIGHANTU

The *Raja Nighantu*, a foundational Ayurvedic text in *Dravyaguna Shastra*, identifies *H. cordifolia* as **Nipa** and **Pitadaru**, prescribing it for disorders such as:

- **Kamala (jaundice)**
- **Atisara (diarrhea/dysentery)**
- **Shotha (inflammation)**
- **Vrana (wounds)** (Dash, 2003)

It is classified as having **Tikta (bitter)** and **Kashaya (astringent)** taste, with **Sheeta (cooling)** virya (potency), and is indicated for pacifying **Pitta** and **Kapha** doshas.

AYURVEDIC AND TRADITIONAL APPLICATIONS

H. cordifolia features prominently in Ayurvedic formulations and folk medicine.

LIVER DISORDERS AND JAUNDICE

Bark decoctions are used in treating **hepatobiliary dysfunctions**. The cooling and astringent qualities assist in regulating bile production and reducing hepatic inflammation (Warrier *et al.* 1995; Nadkarni, 2000).

GASTROINTESTINAL DISORDERS

Its bark powder is administered in **chronic diarrhea and dysentery**, often combined with *Kutaja* (*Holarrhena antidysenterica*) for enhanced anti-microbial effects (Kirtikar and Basu, 1935).

ANTIPYRETIC AND FEBRIFUGE

As an antipyretic, *H. cordifolia* bark decoction is used to reduce fever. Tribal healers in Madhya Pradesh and Odisha administer the decoction during **malarial fevers** and post-infection recovery phases (Jain, 1991; Sahu *et al.* 2013).

SKIN AILMENTS

Topical application of **bark paste** or **leaf decoctions** is used for:

- **Eczema**
- **Psoriasis**
- **Boils and ulcers**- Its anti-inflammatory properties support wound healing (Rastogi and Mehrotra, 1991).

RHEUMATISM AND JOINT PAIN

A decoction of the root is given to relieve **arthritic swelling and muscle stiffness**, often in combination with *Dashamoola* or *Eranda* (*Ricinus communis*) (Kumar *et al.* 2015).

FOLK AND ETHNOMEDICINAL USE

Ethnobotanical surveys have documented *H. cordifolia* across tribal belts in **Chhattisgarh, Jharkhand, Odisha, and Maharashtra**.

- **Gond and Baiga tribes** use bark infusions for **scabies, fevers, and liver problems** (Jain, 1991).
- In **Bastar**, root decoction is used during **snake bites** and **diarrheal outbreaks**.
- In **Assam and Meghalaya**, bark water is

used for **menstrual regulation** and **cleaning infected wounds** (Sharma and Borthakur, 2008).

CROSS-CULTURAL PARALLELS

H. cordifolia is also known in **Sri Lanka, Nepal, and Myanmar** under similar names and is used for analogous medicinal purposes.

- In **Sri Lanka**, bark is used in skin-cleansing tonics (Senanayake, 2004).
- In **Myanmar**, it features in herbal teas to **lower fever** and **purify blood** (Burkill, 1966).
- In **Nepal**, *Haldu* bark is used in **bone fracture healing** (Manandhar, 2002).

PREPARATION AND DOSAGE

TRADITIONAL FORMS

- **Decoction (Kashaya)**: 10–20 g of bark boiled in 200 ml of water.
- **Paste (Lepa)**: Bark powder with neem or turmeric, applied to the skin.
- **Powder (Churna)**: Dried bark consumed with honey or warm water.

CHEMICAL CONSTITUENTS AND MODERN STUDIES

Phytochemical analyses have identified:

- **Flavonoids** (Rastogi and Mehrotra, 1991; Patel *et al.* 2014)
- **Triterpenoids** (Rastogi and Mehrotra, 1991; Patel *et al.* 2014)
- **Saponins** (Rastogi and Mehrotra, 1991; Patel *et al.* 2014)
- **Phenolics** (Rastogi and Mehrotra, 1991; Patel *et al.* 2014)

PHARMACOLOGICAL ACTIVITIES

- **Hepatoprotective**: Protects liver cells in paracetamol-induced hepatotoxicity models (Patel *et al.* 2014).
- **Antipyretic**: Reduces body temperature in experimental fever models (Reddy *et al.* 2011).

- **Antioxidant and anti-inflammatory** properties have also been observed in vitro (Kumar *et al.* 2015).

TIMBER AND ECONOMIC USES

The tree is a high-value **timber species**:

- Wood is yellowish, fine-grained, and durable.
- Used in **furniture, tool handles, carvings, and temple construction** (Troup, 1921).
- Also a source of **natural dye** used in textiles and cosmetics (Burkill, 1966).

CONSERVATION AND SUSTAINABLE HARVESTING

- Due to habitat degradation and overharvesting, *H. cordifolia* has become less common in several forest regions (Ravikumar and Ved, 2000). Conservation strategies include:
- **Community-based management**
- **Agroforestry integration**
- **Seed propagation and nursery practices** (Ravikumar and Ved, 2000)

PHYTOCHEMISTRY

Comprehensive phytochemical analysis of *H. cordifolia* has revealed the presence of:

- **Alkaloids**: Including adifoline (a β -carboline alkaloid), cordifoline
- **Flavonoids**: Such as 7,4-dimethoxy-5-hydroxyflavanone
- **Coumarins**: Including 7-apiglucoside of umbelliferone (adicardin)
- **Phenolic compounds**: Umbelliferone, benzoic acid
- **Sterols**: β -sitosterol
- **Hydrocarbons**: n-heneicosane, n-tricosane, n-pentacosane, n-pentatriacontane
- **Essential oils**: 5.2%–6.8% in oleoresin

These compounds have shown potential in various pharmacological evaluations, especially those related to microbial resistance and oxidative stress (Negi *et al.* 2022).

PHARMACOLOGICAL ACTIVITIES

❖ ANTIMICROBIAL ACTIVITY

Crude extracts from the bark and heartwood exhibited inhibitory effects against several pathogenic bacteria including:

- *Bacillus anthracis*
- *Staphylococcus aureus*
- *Salmonella paratyphi*
- *Pseudomonas spp.*
- *Vibrio cholerae*
- *Neisseria gonorrhoeae*

Additionally, flavonoid isolates showed moderate antifungal activity against *Aspergillus fumigatus* and *Cryptococcus neoformans* (Rokade and Pawar, 2013).

❖ ANTIFERTILITY EFFECTS

Administration of ethanolic leaf extract in female rats demonstrated significant anti-implantation and abortifacient effects, especially when given during early gestation. Stem bark extract also showed spermatotoxic effects in male rats.

❖ HEPATOPROTECTIVE AND ANTIOXIDANT ACTIVITY

Acetone and aqueous extracts of the leaves and bark demonstrated hepatoprotective effects in experimental models, along with significant antioxidant activity attributed to phenolic and flavonoid content.

❖ ANTIDIABETIC ACTIVITY

Preliminary evaluations indicated hypoglycemic effects, although further mechanistic studies are required.

❖ OTHER ACTIVITIES

While traditional applications suggest antimalarial potential, experimental studies reported no significant antiplasmodial activity against *Plasmodium berghei* in *in vivo* models.

MEDICINAL APPLICATIONS

PLANT PART	TRADITIONAL USE
Root	Astringent, used in diarrhea and dysentery
Bark	Used for skin disorders, fever, ulcers, liver ailments
Leaves	Hepatoprotective, antioxidant
Flowers	Headache relief
Buds	Antidote to toxins

The multifaceted use of *H. cordifolia* in ethnomedicine highlights its importance in treating both acute and chronic ailments. Its bioactive constituents make it a strong candidate for modern pharmaceutical exploration (Negi *et al.* 2022).

CONCLUSION AND FUTURE DIRECTIONS

Haldina cordifolia is a phytochemically rich and pharmacologically active plant species with significant ethnomedicinal value. Although initial studies have demonstrated promising biological activities, extensive pharmacokinetic, toxicological, and clinical research is needed to fully validate its therapeutic potential.

This review, therefore, highlights the imperative for prioritized bio-prospecting and drug discovery efforts centered on *H. cordifolia*. Future research should particularly focus on exploring its role in combating infectious diseases, managing reproductive health conditions, and providing hepatoprotective interventions-areas where preliminary findings have shown notable promise. Collaborative approaches spanning phytochemistry, pharmacology, molecular biology, and clinical sciences could transform this traditionally valued plant into a scientifically validated reservoir of novel therapeutic agents.

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