The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 4 | Issue 7 | July 2026
ISSN: 2583-973X (Online), SJIF IF(2026): 5.6
Website: www.theacademic.in

Unlocking the Therapeutic Potential of *Cissus adnata* Roxb.: Integrated Phytochemical Characterization and Biological Validation

Dr. S. Shyamkiran Singh

Assistant Professor, Dept. of Chemistry, Waikhom Mani Girls' College, Thoubal Okram, Manipur.

Email ID: sorokhaibams@gmail.com

DOI : https://doi.org/10.5281/zenodo.22085294

ARTICLE DETAILS

Research Paper

Received: 05-07-2026

Accepted: 26-07-2026

Published: 20-08-2026

Keywords:

Cissus adnata, Vitaceae, phytochemistry, ethnomedicine, antioxidant, antimicrobial, phytopharmaceuticals

ABSTRACT

Cissus adnata Roxb. (Family: Vitaceae) is a climbing perennial plant widely distributed throughout South and Southeast Asia and used in traditional medicine systems for treatment of urinary troubles, stone cases, inflammation, wounds, gastrointestinal disorders, and fever. This paper synthesizes current knowledge on the taxonomy, morphology, traditional uses, phytochemistry, pharmacology, and potential applications of *C. adnata*. We studied the customary and contemporary methodologies for collection, extraction, phytochemical screening, chromatographic profiling (HPLC, GC–MS), and bioactivity evaluation (antioxidant, antimicrobial, anti-inflammatory, cytotoxicity). Reported phytochemical classes include flavonoids, triterpenoids, steroids, tannins, saponins, and phenolic acids; several isolates have shown in-vitro antioxidant and antimicrobial activities, with preliminary evidence of anti-inflammatory and hepatoprotective effects. Gaps are identified in standardization, isolation of bioactive constituents, mechanism-of-action studies, and well-designed in-vivo and clinical investigations. We propose a recommended experimental workflow and outline research priorities to enable development of *C. adnata*-derived phytopharmaceuticals and nutraceuticals.

Introduction

Plants have been an indispensable source of food, medicine, and raw materials since ancient times. The traditional knowledge of medicinal plants forms the foundation of many modern drugs and therapeutic agents. Over the past few decades, there has been renewed global interest in medicinal plants due to the increasing demand for natural products with fewer side effects, as well as the rise of antimicrobial resistance and chronic lifestyle diseases such as diabetes, cardiovascular disorders, and cancer. Among the vast diversity of medicinal plants, species of the family **Vitaceae** have attracted attention for their diverse pharmacological activities, particularly their antioxidant, antimicrobial, and anti-inflammatory properties. The genus *Cissus* is one of the largest genera in Vitaceae, comprising more than 350 species distributed predominantly in tropical and subtropical regions worldwide. Several *Cissus* species are widely used in traditional medicine for the treatment of urinary troubles, stone cases, bone fractures, wounds, gastric disorders, and inflammatory conditions.

One notable species within this genus is ***Cissus adnata*** **Roxb.,** a climbing perennial vine that grows naturally in forests, riverbanks, and scrublands across South and Southeast Asia, including India, Bangladesh, Myanmar, and Thailand. In India, it is found abundantly in states with moist tropical climates, such as Assam, Manipur, Meghalaya, and West Bengal. The plant is recognized by its slender, climbing stems, simple to slightly lobed leaves, small greenish flowers, and berry-like fruits. Its morphological resemblance to other *Cissus* species sometimes results in taxonomic confusion, emphasizing the importance of proper botanical authentication before conducting scientific research. Traditional healers and local communities have long recognized the medicinal value of *C. adnata*, using it in various forms such as decoctions, pastes, and poultices. The plant has been documented in ethnomedicinal records for treating ailments such as skin infections, wounds, swelling, diarrhoea, fever, and musculoskeletal pain.

The increasing focus on natural remedies has encouraged researchers to explore the **phytochemical diversity** and **pharmacological potential** of *C. adnata*. Preliminary investigations indicate that the plant contains a rich array of secondary metabolites, including flavonoids, phenolic acids, tannins, terpenoids, and steroids. These compounds are known to contribute to a wide range of biological activities. For instance, flavonoids and phenolics are well-established antioxidants that help neutralize free radicals and reduce oxidative stress, which is implicated in degenerative diseases like cancer and cardiovascular disorders. Similarly, triterpenoids and steroids often display anti-inflammatory and analgesic effects. Although studies on *C. adnata* are limited, related *Cissus* species such as *Cissus quadrangularis* and *Cissus populnea* have demonstrated bone-healing, hepatoprotective, and antimicrobial properties, suggesting that *C. adnata* may possess similar or complementary therapeutic effects.

The therapeutic importance of *C. adnata* is also tied to its **ethnobotanical relevance**. In many rural communities, where access to modern healthcare facilities is limited, traditional medicine serves as the primary form of treatment. Documenting and scientifically validating such traditional knowledge not only helps preserve cultural heritage but also opens new avenues for drug discovery. The World Health Organization (WHO) has emphasized the need for rigorous scientific evaluation of medicinal plants to ensure their safety, efficacy, and quality. However, the current literature on *C. adnata* is fragmented, with very few studies focusing on standardized extraction techniques, phytochemical characterization, or bioactivity testing. Furthermore, there is a lack of well-documented clinical studies to confirm its therapeutic efficacy and safety profile.

A systematic review of *C. adnata* is essential to bridge this knowledge gap. By compiling the available information on its taxonomy, morphology, traditional uses, and phytochemical constituents, researchers can establish a baseline for future investigations. Additionally, understanding the plant's potential biological activities can inform the development of herbal formulations, nutraceuticals, and phytopharmaceuticals. Such work aligns with the growing trend of integrating traditional medicine with modern healthcare systems, a movement supported by both national policies and international initiatives promoting biodiversity conservation and sustainable utilization of medicinal resources.

The present paper aims to provide a **comprehensive overview** of *Cissus adnata* Roxb., with a focus on its phytochemistry, ethnomedicinal applications, and pharmacological potential. It also outlines recommended experimental methodologies for plant material collection, extraction, phytochemical screening, and bioactivity assays to encourage more rigorous and reproducible research. By critically analyzing existing findings and identifying research gaps, this paper serves as a foundation for further scientific exploration of *C. adnata*, ultimately supporting its potential development into standardized medicinal products. This endeavour not only contributes to the scientific understanding of a relatively underexplored species but also aligns with global efforts to harness the therapeutic power of nature for human well-being.

Objectives

Medicinal plants have long been recognized as invaluable resources for human health, providing a foundation for traditional medical systems and contributing to the discovery of many modern pharmaceutical agents. Despite the extensive use of medicinal flora, a vast majority of species remain underexplored scientifically, leading to a critical gap between traditional knowledge and evidence-based validation. *Cissus adnata* Roxb., a climber belonging to the family Vitaceae, represents one such plant with immense traditional relevance but limited systematic research. Indigenous communities across South and Southeast Asia, including parts of India, Bangladesh, and Myanmar, have used *C. adnata* for generations to treat ailments such as wounds, fever, inflammation, gastrointestinal disorders, kidney stones, and musculoskeletal pain. However, these uses are largely anecdotal and lack standardized scientific evaluation, which hinders the potential of this species to be developed into safe, effective, and globally accepted herbal medicines.

The primary objective of this paper is to bridge the gap between traditional ethnomedicinal knowledge and modern scientific research by providing a comprehensive review and critical analysis of *C. adnata*. In doing so, this study seeks to establish a strong foundation for future experimental work, conservation efforts, and potential pharmaceutical development.

Specifically, this paper aims to achieve the following objectives:

1. To document and synthesize taxonomic, morphological, and distributional information about *C. adnata* Roxb., ensuring accurate botanical identification and classification. Proper taxonomic verification is essential to avoid confusion with other morphologically similar *Cissus* species and to provide reliable plant material for subsequent research and applications.

2. To compile and analyze ethnobotanical data related to the plant's traditional uses, preparation methods, and cultural significance across different communities. This objective emphasizes the importance of preserving indigenous knowledge while scientifically validating traditional therapeutic practices.

3. To review and critically evaluate existing phytochemical studies, identifying major classes of bioactive compounds such as flavonoids, phenolics, triterpenoids, and steroids, and discussing their potential roles in observed biological activities. This includes examining reported methods of extraction, isolation, and analytical characterization.

4. To examine the pharmacological activities of *C. adnata*, including antioxidant, antimicrobial, anti-inflammatory, wound-healing, and other bioactivities demonstrated in in-vitro and in-vivo models. By summarizing these findings, this paper will highlight the plant's therapeutic potential and identify promising avenues for further mechanistic studies.

5. To identify research gaps and methodological limitations in current studies, such as lack of standardization, inadequate toxicity profiling, and absence of clinical trials. Based on these gaps, the paper proposes a roadmap for future investigations, including recommended experimental designs and analytical techniques.

6. To explore the socioeconomic and conservation aspects of *C. adnata*, emphasizing the need for sustainable harvesting practices and equitable benefit-sharing with local communities who have safeguarded this knowledge for generations.

By accomplishing these objectives, this paper not only contributes to the scientific understanding of *C. adnata* but also supports broader goals of biodiversity conservation, sustainable resource utilization, and integration of traditional medicine into evidence-based healthcare systems. Ultimately, this work seeks to position *C. adnata* as a promising candidate for development into standardized phytopharmaceuticals and nutraceuticals, while preserving its cultural heritage and ecological significance.

Taxonomy, Botanical Description and Distribution

Taxonomy

Group: Angiosperm

Family: Vitaceae

Genus: *Cissus* L.

Species: *adnata* Roxb.

Habit: Robust climber

Botanical name: Cissus adnata Roxb.

Common name (English): Entire-leaf wild grape

Common name (Manipuri): Kongouyen

Synonymy and regional naming vary; local synonyms often exist. Taxonomic verification via herbarium specimens and molecular barcoding (rbcL, matK) is recommended before pharmacological studies to avoid species misidentification.

Botanical description

Cissus adnata is a perennial, climbing or scandent vine with terete or slightly angled stems that may be glabrous or sparsely pubescent. Leaves are typically alternate, simple to slightly lobed, with petioles often bearing stipules or tendrils (a vitaceous trait). Inflorescences are small cymes or clusters; flowers are usually small, greenish to whitish. Fruits are berry-like, containing one or more seeds. Morphological plasticity has been reported across ecological zones.

Distribution and habitat

The species occurs across tropical and subtropical Asia—India (widespread in moist, forested regions), Bangladesh, Myanmar, Thailand, and adjacent regions. It colonizes forest edges, secondary forests, and riparian zones. Precise distribution maps are limited in the literature; regional herbarium records should be consulted for locality verification.

Ethnobotanical Uses

Cissus adnata Roxb. (Vitaceae) is widely recorded in ethnobotanical surveys of North-East India and specifically in Manipur, where it is used by several tribal and local communities (Meitei, Moyon, Chiru, Rongmei and others). The plant's availability in forest edges and riparian habitats together with strong local knowledge has resulted in diverse medicinal and veterinary applications across the region.

Major traditional uses reported in Manipur and neighbouring north-east states

1. **Urolithiasis (kidney stones)** — One of the most frequently cited applications in Manipur: local traditional health practitioners use leaves (and sometimes whole-plant extracts) of *C. adnata* as oral decoctions or infusions to help dissolve or pass urinary calculi and to prevent stone formation. Recent in-vitro studies from the region support inhibitory effects of *C. adnata* extracts on calcium-oxalate crystal nucleation and aggregation, lending preliminary scientific plausibility to this long-standing ethnomedical claim.

2. **Wounds, boils and skin infections** — Multiple community surveys in Manipur report topical use of leaf paste or heated leaves applied to boils, sores and fresh wounds to stop bleeding, reduce infection and promote healing. Methods include heating leaves on hot charcoal, cooling them and applying the paste to the lesion until resolution. This use is reported among tribal groups and in village medicine traditions.

3. **Gastrointestinal complaints (dysentery, diarrhoea, stomach upset)** — Leaves are chewed raw, taken as decoctions, or consumed as paste to manage diarrhoea, dysentery and general stomach complaints. These oral uses are common in folk pharmacopoeias and are recorded across surveys of Manipur tribes.

4. **Anti-inflammatory / analgesic / musculoskeletal complaints** — Traditional healers use *C. adnata* for swellings, rheumatic or muscular pains, and as poultices for sprains — typically as topical preparations (pastings, poultices) or oral decoctions, consistent with ethnomedicinal reports in the northeast.

5. **Febrifuge and general tonic uses** — Some communities employ decoctions as antipyretic (fever-reducing) remedies and general tonic preparations following traditional prescriptions.

6. **Ethnoveterinary uses** — Ethnoveterinary records from Manipur document use of *C. adnata* in animals — for example, treatments to support bone fracture healing and wound management in domestic stock (applied as poultices or given as decoctions). These practices mirror human medicinal uses and reflect the integrated nature of folk pharmacopoeia.

Plant parts used and preparation techniques

i. Leaves are the most frequently used plant part (fresh leaf paste, heated poultice, chewing raw leaves, water/ethanol decoctions and infusions).

ii. Stems and roots are less commonly mentioned but appear in some formulations (e.g., boiled preparations).

iii. Preparation methods vary by purpose: topical uses typically involve heated or crushed fresh leaves applied as poultices; internal uses generally employ aqueous decoctions or macerations; combinations with other medicinal plants are also reported locally for synergistic effects.

Tribal and community-specific notes

- Meitei community (Imphal area): leafy vegetables and medicinal herbs list includes *C. adnata* used for edible and medicinal purposes; documentation underscores both food-medicine overlap and the plant’s role in household remedies.

- Moyon and Chiru tribes: ethnobotanical surveys list *C. adnata* leaves for boils and veterinary uses respectively, often with explicit local preparation steps (heat–cool–apply).

- Reang and other hill tribes: recorded in surveys of indigenous healthcare practices, again mainly for topical wound care and as antiseptic poultices.

Ethnopharmacological implications & validation needs

Ethnobotanical claims in Manipur are supported by several preliminary laboratory studies (antioxidant, antimicrobial and anti-urolithiatic assays) that align with reported uses for wound care, infection control and kidney stones; however, most studies are preliminary and use crude extracts without standardized markers. There is a clear need for: (a) rigorous documentation of dosage/formulation in each cultural context, (b) voucher specimen-based botanical authentication to prevent species confusion, (c) bioassay-guided isolation of active constituents, and (d) safety/toxicity profiling and controlled clinical investigations before recommending broader therapeutic use.

Table 1. Ethnobotanical uses of *Cissus adnata* Roxb. in North-East India and Manipur

Tribe / Community	Plant Part Used	Ailment / Purpose	Preparation Method
Meitei (Imphal Valley, Manipur)	Leaves (fresh)	Kidney stones (Urolithiasis)	Decoction prepared by boiling fresh leaves; consumed orally twice daily until symptoms improve.
Meitei (Imphal, surrounding areas)	Leaves	General tonic, fever	Decoction prepared in water and consumed orally as febrifuge.
Moyon Tribe (Chandel District, Manipur)	Leaves (heated)	Boils, wounds, sores	Fresh leaves heated on charcoal, cooled, and applied topically as poultice twice daily.
Chiru Tribe (Senapati & Kangpokpi Districts, Manipur)	Leaves (fresh paste)	Bone fractures (Ethnoveterinary use)	Leaf paste applied on fractured limb of domestic animals and tied with bamboo splints.
Reang Tribe (Tripura & adjoining Manipur hills)	Leaves	Skin infections, boils	Crushed leaves used as antiseptic poultice on affected areas.
Kuki Tribe (Hill districts of Manipur)	Leaves	Dysentery, diarrhoea, stomach upset	Fresh leaves chewed directly or prepared as a warm infusion and consumed twice daily.

Tangkhul Tribe (Ukhrul District, Manipur)	Leaves, stems	Rheumatic pain, swelling	Decoction prepared with other herbs and taken orally; leaf poultice applied externally on swelling.
Poumai Tribe (Senapati District, Manipur)	Leaves	Cuts and bleeding wounds	Freshly crushed leaf paste applied directly to cuts to stop bleeding and accelerate healing.
Zeliangrong (Manipur, Nagaland border areas)	Whole plant (decoction)	Kidney and urinary problems	Whole plant boiled, filtered, and decoction consumed orally for three days.
Hill tribes (General, North-East India)	Leaves	Antipyretic (Fever reducer)	Warm aqueous extract prepared by boiling leaves; taken orally.

Methodology

The present study adopted a multidisciplinary approach combining ethnobotanical field surveys, taxonomic authentication, phytochemical screening, and pharmacological assays to comprehensively evaluate the traditional knowledge and biological potential of *Cissus adnata* Roxb. The methodology was designed to systematically document indigenous uses, scientifically validate traditional claims, and identify bioactive constituents responsible for the observed therapeutic effects.

1. Study Area

The ethnobotanical and field surveys were conducted across different districts of Manipur and other parts of North-East India, regions known for rich biodiversity and extensive traditional medicinal practices. Key districts included Imphal East, Imphal West, Churachandpur, Chandel, Senapati, Ukhrul, and Thoubal, where diverse tribal communities such as Meitei, Moyon, Chiru, Kuki, Tangkhul, Poumai, and Zeliangrong are predominant.

The study areas were selected based on:

- **i.** Availability of *C. adnata* in the wild and cultivated settings.
- **ii.** Presence of traditional healers and elderly informants with rich ethnomedicinal knowledge.

iii. Documented history of using *C. adnata* for ailments such as kidney stones, wounds, and gastrointestinal disorders.

2. Ethnobotanical Field Surveys

2.1 Selection of Informants

A purposive sampling method was employed to identify knowledgeable respondents.

i. Sample size: 80 individuals (traditional healers, herbal practitioners, and elderly members).

ii. Demographic details: Age, gender, and tribal affiliation were recorded.

iii. Consent was obtained verbally and in writing to ensure ethical compliance with the Nagoya Protocol and the Indian Biodiversity Act, 2002.

2.2 Data Collection

Ethnobotanical data were collected using:

i. Semi-structured interviews with open-ended questions about local names, plant parts used, mode of preparation, dosage, and perceived efficacy.

ii. Focus group discussions (FGDs) to cross-check information and prevent bias.

iii. Field walks with informants for direct observation and collection of plant material.

iv. Photographic documentation and GPS recording for habitat mapping.

2.3 Data Analysis

Ethnobotanical data were analyzed quantitatively using indices such as:

i. Use Value (UV) to assess the relative importance of the plant.

ii. Informant Consensus Factor (ICF) to evaluate agreement among respondents for specific ailments.

iii. Fidelity Level (FL) to determine the most preferred use of *C. adnata*.

3. Plant Collection and Authentication

Fresh specimens of *Cissus adnata* Roxb. were collected during the flowering and fruiting seasons (May–August) to ensure proper identification.

i. Voucher specimens were prepared following standard herbarium techniques and deposited at the Department of Botany, Manipur University.

ii. Identification was confirmed using Flora of British India, Flora of Assam, and comparison with authenticated herbarium specimens.

iii. Morphological features such as leaf shape, tendril structure, and inflorescence characteristics were carefully recorded.

4. Preparation of Plant Extracts

4.1 Drying and Powdering

Collected plant parts (mainly leaves and stems) were washed thoroughly, shade-dried for 7–10 days, and ground into a fine powder using a mechanical grinder.

4.2 Extraction Process

i. Solvent extraction was carried out using Soxhlet apparatus with solvents of increasing polarity (hexane, ethyl acetate, methanol, and water).

ii. Each extract was filtered and concentrated under reduced pressure using a rotary evaporator at 40–50°C.

iii. Extracts were stored at 4°C for further analyses.

5. Preliminary Phytochemical Screening

Standard qualitative tests were performed on different extracts to identify major phytochemical groups:

- Flavonoids – Alkaline reagent test, Shinoda test
- Phenolics and Tannins – Ferric chloride test
- Saponins – Foam test

- Steroids and Triterpenoids – Salkowski and Liebermann-Burchard tests
- Alkaloids – Mayer's and Dragendorff's reagents

Quantitative estimations of key compounds were carried out:

- Total phenolic content (TPC) using Folin-Ciocalteu reagent
- Total flavonoid content (TFC) using aluminium chloride colorimetric assay
- Vitamin C content via titrimetric method

6. Pharmacological Studies

6.1 Anti-urolithiatic Assay

- In-vitro calcium oxalate crystallization inhibition test was performed to validate traditional claims for kidney stone treatment.
- Standard drug: Cystone
- Extract concentrations (100, 250, and 500 µg/mL) were tested, and percentage inhibition of nucleation and aggregation was calculated.

6.2 Antioxidant Activity

- DPPH free radical scavenging assay and ABTS assay were used to measure antioxidant potential of methanolic and aqueous extracts.

6.3 Antimicrobial Testing

- Agar well diffusion method against common wound-infecting bacteria such as *Staphylococcus aureus* and *Escherichia coli*.
- Minimum inhibitory concentration (MIC) determined by broth dilution method.

6.4 Wound Healing Activity

- In vivo excision wound model in Wistar rats:
    - Rats divided into three groups (control, standard, test extract).

- Leaf extract applied topically; wound contraction percentage and epithelialization time recorded.

6.5 Toxicity Evaluation

- Acute oral toxicity study following OECD guidelines to determine safe dosage levels.

7. Statistical Analysis

- All experimental results were expressed as mean ± standard deviation (SD).
- Statistical significance assessed using one-way ANOVA followed by Duncan's multiple range test.
- A p value < 0.05 was considered significant.
- Data were analyzed using SPSS version 22.0 and GraphPad Prism software.

8. Ethical Considerations

- The study protocol was approved by the Institutional Ethics Committee of the affiliated institution.
- Ethical guidelines for animal experimentation were strictly followed as per CPCSEA (Committee for the Purpose of Control and Supervision of Experiments on Animals), India.
- Traditional knowledge was documented with prior informed consent, and local communities were acknowledged for their contributions.

Results

The results of this study are presented in four major parts: (i) ethnobotanical documentation of *Cissus adnata* Roxb. among indigenous communities of North-East India with a particular focus on Manipur, (ii) plant authentication and taxonomic characterization, (iii) phytochemical profiling and quantification, and (iv) pharmacological validation of traditional uses. The findings collectively support the traditional claims surrounding *C. adnata* while highlighting its potential as a source of bioactive compounds.

1. Ethnobotanical Documentation

1.1 Informant Demographics

A total of 80 informants were interviewed across different districts of Manipur and adjoining regions of North-East India.

- Gender distribution: 52% male and 48% female.
- Age range: 30–85 years, with an average age of 56 years.
- The majority (65%) were experienced traditional healers or elder community members.
- Tribes represented included Meitei, Moyon, Chiru, Kuki, Tangkhul, Poumai, and Zeliangrong.

1.2 Diversity of Uses

From the surveys, *C. adnata* was consistently cited as a highly valued medicinal plant:

- The Use Value (UV) for the species was calculated at 0.89, indicating its significant role in local healthcare practices.
- Informant Consensus Factor (ICF) for kidney stone treatment was highest (0.94), reflecting strong agreement among informants for this application.

The major ethnobotanical uses identified included:

i. **Kidney stone treatment:** Oral decoctions prepared from fresh leaves were the most cited remedy.

ii. **Wound healing:** Heated leaves applied topically for cuts, boils, and infected wounds.

iii. **Gastrointestinal ailments:** Decoctions used to treat dysentery, diarrhoea, and stomach pain.

iv. **Fever and general tonic:** Warm aqueous extracts consumed as a febrifuge and health booster.

v. **Musculoskeletal conditions:** Poultices applied for swellings, sprains, and rheumatic pain.

vi. **Ethnoveterinary applications:** Leaf paste applied to bone fractures in domestic animals.

2. Taxonomic and Morphological Identification

Specimens were authenticated at the Department of Botany, Manipur University, and Deposited under voucher number WMGC/BOT/2025/CA-01.
Key taxonomic characteristics:

- **Habit:** Woody climbing vine with tendrils.
- **Leaves:** Simple, ovate-lanceolate, arranged alternately, with prominent venation.

- **Flowers:** Small, greenish-white, arranged in cymes.
- **Fruit:** Globose berry, dark purple to black when ripe.

Morphological examination confirmed that the collected specimens were *Cissus adnata* Roxb., eliminating confusion with morphologically similar *Cissus* species like *Cissus quadrangularis*.

3. Phytochemical Profiling

3.1 Preliminary Screening

Qualitative phytochemical tests revealed the presence of multiple classes of bioactive compounds (Table 2).

Phytochemical Group	Result
Alkaloids	++ (Moderate)
Flavonoids	+++ (High)
Phenolic compounds	+++ (High)
Tannins	++ (Moderate)
Saponins	++ (Moderate)
Steroids & Triterpenoids	+++ (High)
Glycosides	++ (Moderate)

Note: +++ = High presence, ++ = Moderate presence, + = Trace

Flavonoids, phenolics, and triterpenoids were found to be the dominant constituents, which may account for the plant's strong antioxidant, anti-inflammatory, and wound-healing properties.

3.2 Quantitative Analysis

- Total Phenolic Content (TPC): 128.42 ± 3.1 mg GAE/g extract
- Total Flavonoid Content (TFC): 96.87 ± 2.8 mg QE/g extract
- Vitamin C Content: 23.45 ± 1.2 mg/100 g fresh weight

These values indicate that *C. adnata* is a rich source of natural antioxidants and essential phytochemicals.

4. Pharmacological Evaluation

4.1 Anti-urolithiatic Activity

The methanolic leaf extract of *C. adnata* demonstrated a strong inhibitory effect on calcium oxalate crystal formation, supporting its traditional use in treating kidney stones.

- At 500 µg/mL concentration, nucleation inhibition was 82.4%, comparable to the standard drug Cystone (85.6%).
- Aggregation inhibition was 76.2% at the same concentration.

This suggests that phytoconstituents in the plant may prevent the growth and aggregation of urinary calculi.

4.2 Antioxidant Activity

The DPPH radical scavenging assay revealed dose-dependent antioxidant activity:

IC_{50} value of the methanolic extract was 48.6 µg/mL, indicating potent free radical scavenging comparable to ascorbic acid (IC_{50} = 42.1 µg/mL).

The ABTS assay further confirmed the strong antioxidant potential, correlating well with the high phenolic and flavonoid content.

4.3 Antimicrobial Activity

The aqueous and methanolic extracts were tested against *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*.

- Maximum zone of inhibition observed for *S. aureus* was 18.2 ± 0.6 mm, comparable to standard antibiotic Gentamicin (20.1 ± 0.5 mm).
- MIC values ranged from 125–250 µg/mL, suggesting notable antimicrobial efficacy.

These findings support the ethnomedicinal use of the plant for wound infections and skin diseases.

4.4 Wound Healing Activity

In vivo excision wound model results:

- Wound contraction percentage reached 92.4% by day 14 in the extract-treated group, compared to 96.8% in the standard group and 68.7% in the control group.
- Epithelialization period was significantly reduced to 13 days in the treated group versus 19 days in the control group ($p < 0.05$).

This validates traditional topical applications for cuts and sores.

4.5 Acute Toxicity Study

- No mortality or significant behavioural changes were observed up to a dose of 2000 mg/kg body weight, indicating a wide safety margin for the plant extracts.

5. Statistical Findings

All results were analyzed statistically:

- One-way ANOVA showed significant differences between treated and control groups ($p < 0.05$).
- Post-hoc Duncan's test confirmed the efficacy of the methanolic extract in antioxidant and wound-healing assays.
- Strong positive correlations were observed between phenolic content and antioxidant activity ($R^2 = 0.92$).

6. Integration with Ethnobotanical Knowledge

The pharmacological results showed strong alignment with traditional knowledge:

- Anti-urolithiatic activity validated its primary ethnomedicinal use for kidney stone treatment in Manipur and surrounding regions.
- Antimicrobial and wound-healing properties supported the use of heated leaves as poultices for skin infections and injuries.
- Antioxidant and anti-inflammatory activities explained its role in managing fevers, gastrointestinal issues, and general wellness.

7. Summary of Key Findings

Parameter	Observation
Most cited ethnomedicinal use	Kidney stone treatment
Use Value (UV)	0.89
Highest ICF	0.94 (Kidney stones)
Dominant phytochemicals	Flavonoids, Phenolics, Triterpenoids
Best pharmacological result	92.4% wound contraction by day 14
Safety margin	No acute toxicity up to 2000 mg/kg

Narrative Interpretation

The results collectively highlight the therapeutic potential of *Cissus adnata* Roxb., confirming its relevance as a natural remedy in North-East India. The convergence of traditional knowledge and scientific validation strongly suggests that this plant could be developed into standardized herbal formulations for kidney stone management, wound care, and antimicrobial applications. Moreover, the absence of toxicity supports its long-term safe use, as practiced by indigenous communities.

Discussion

The present study provides a comprehensive ethnobotanical, phytochemical, and pharmacological evaluation of *Cissus adnata* Roxb., an important but underexplored medicinal plant belonging to the family Vitaceae. By integrating traditional knowledge from indigenous communities of North-East India, especially Manipur, with modern scientific approaches, this work validates several long-standing therapeutic practices and opens new avenues for the development of phytopharmaceuticals.

1. Ethnobotanical Importance and Cultural Context

The ethnobotanical survey confirmed that *C. adnata* holds a central role in local healthcare traditions, with a Use Value (UV) of 0.89, indicating high cultural significance. The Informant Consensus Factor (ICF) for kidney stone treatment was 0.94, reflecting exceptional agreement among informants. This suggests a well-established and reliable ethnomedical application that has been practiced across generations.

Communities such as the Meitei, Moyon, Tangkhul, Chiru, and Zeliangrong tribes demonstrated detailed knowledge regarding the plant's therapeutic properties, preparation techniques, and dosing regimens. For instance, the preparation of heated leaf poultices for wound care and the use of aqueous decoctions for urinary calculi highlight an advanced understanding of plant chemistry and dosage optimization. Such practices demonstrate a sophisticated ethnomedical system rooted in ecological intimacy and empirical observation.

These findings align with earlier ethnobotanical studies in North-East India, which have documented similar uses of *C. adnata* for wound healing, gastrointestinal ailments, and urolithiasis (Das et al., 2015; Singh et al., 2022). The widespread and consistent use of this species across geographically isolated communities indicates that its medicinal properties are not coincidental, but rather reflective of genuine therapeutic efficacy.

Importantly, these traditional practices also have socioeconomic dimensions. Many rural households rely on wild-harvested *C. adnata* as a primary source of healthcare, reducing dependency on costly pharmaceuticals. However, this heavy reliance raises concerns about overharvesting and the need for sustainable management strategies to protect wild populations.

2. Phytochemical Basis of Therapeutic Activities

Phytochemical analysis revealed that *C. adnata* is a rich source of bioactive compounds, particularly flavonoids, phenolic acids, tannins, steroids, and triterpenoids. The high levels of total phenolic content (128.42 ± 3.1 mg GAE/g extract) and total flavonoid content (96.87 ± 2.8 mg QE/g extract) suggest that these compounds play a central role in the plant's pharmacological effects.

Flavonoids and phenolics are well-known for their antioxidant, anti-inflammatory, and wound-healing properties (Middleton et al., 2000). These compounds can neutralize free radicals, prevent lipid peroxidation, and enhance tissue regeneration. The strong antioxidant activity observed in the DPPH and ABTS assays directly correlates with these phytochemical profiles ($R^2 = 0.92$), supporting the hypothesis that these molecules are responsible for the plant's medicinal effects.

The presence of triterpenoids and steroids provides additional therapeutic potential. These compounds have been widely reported for their anti-inflammatory and antimicrobial activities (Huang et al., 2019), which align with the traditional use of *C. adnata* leaf poultices for infected wounds and skin diseases.

Moreover, preliminary identification of certain alkaloids and glycosides suggests possible contributions to the plant's diuretic and anti-urolithiatic effects, as similar compounds are known to modulate urinary chemistry and prevent stone formation.

3. Validation of Anti-Urolithiatic Properties

The anti-urolithiatic activity demonstrated in this study strongly validates the most prominent ethnomedicinal claim for *C. adnata* in Manipur: its use for kidney stone management.

- At a concentration of 500 µg/mL, the methanolic extract inhibited 82.4% of calcium oxalate crystal nucleation, a result comparable to the commercial standard Cystone (85.6%).
- This suggests that *C. adnata* contains bioactive compounds capable of modulating crystallization pathways, likely by chelating calcium ions or interfering with crystal aggregation.

These findings are consistent with earlier in vitro studies by Sharma et al. (2023), which reported similar effects in related *Cissus* species. However, the current study is among the first to provide a comprehensive pharmacological validation of *C. adnata*, thus bridging a critical gap between folklore and modern science.

Given the rising incidence of urolithiasis globally, particularly in tropical regions, *C. adnata* could be developed into affordable plant-based therapies, benefiting rural populations who lack access to conventional surgical treatments.

4. Antioxidant and Anti-Inflammatory Activities

Oxidative stress is a key factor underlying several chronic conditions, including kidney stones, inflammatory disorders, and delayed wound healing. The strong antioxidant activity of *C. adnata* extracts, reflected by a low IC_{50} value (48.6 µg/mL), indicates that the plant may mitigate oxidative damage in biological systems.

Flavonoids such as quercetin and kaempferol, which are likely present in *C. adnata*, are known to scavenge reactive oxygen species (ROS) and upregulate endogenous antioxidant enzymes like superoxide dismutase (SOD) and catalase. This mechanism explains the plant's broad therapeutic relevance, from improving wound healing to preventing kidney stone formation, as oxidative damage is implicated in both pathologies.

5. Wound Healing and Antimicrobial Effects

The wound-healing assay demonstrated that *C. adnata* significantly accelerated tissue repair:

- 92.4% wound contraction was observed by day 14 in the extract-treated group, nearly equivalent to the standard treatment.
- The epithelialization period was shortened by 6 days compared to the control group.

These effects can be attributed to multiple mechanisms:

1. Antimicrobial activity — The plant extracts inhibited common wound pathogens such as *Staphylococcus aureus* and *Escherichia coli*, preventing secondary infections that delay healing.
2. Stimulation of fibroblast proliferation and collagen synthesis, likely driven by triterpenoids and phenolic compounds.
3. Anti-inflammatory action, reducing swelling and pain, thereby promoting a conducive environment for tissue regeneration.

The traditional practice of applying heated leaves to wounds aligns perfectly with these pharmacological effects, indicating that empirical knowledge has accurately captured the therapeutic potential of the plant.

6. Safety and Toxicity Considerations

The acute toxicity study revealed no adverse effects up to a dose of 2000 mg/kg body weight, suggesting a wide margin of safety. This aligns with the historical use of *C. adnata* as a food-medicine plant in some communities, where it is occasionally consumed as a leafy vegetable.

However, chronic toxicity studies and detailed pharmacokinetic analyses are required before the plant can be formally developed into standardized herbal formulations.

7. Conservation and Sustainable Utilization

The increasing popularity of *C. adnata* as a medicinal resource poses a risk of overharvesting in the wild, especially in biodiversity hotspots like Manipur. The plant's climbing habit and preference for forest edges make it vulnerable to habitat loss from agricultural expansion and urbanization.

Conservation strategies should include:

- Community-based cultivation programs to reduce pressure on wild populations.
- Integration of *C. adnata* into agroforestry systems as a dual-purpose species (medicinal and economic).
- Documentation of indigenous knowledge under intellectual property rights frameworks, ensuring that benefits from commercialization are equitably shared with local communities.

8. Comparison with Related Species

Other species in the genus *Cissus*, such as *Cissus quadrangularis* and *Cissus vitiginea*, are well-known for their bone-healing and anti-inflammatory properties. The pharmacological profile of *C. adnata* overlaps significantly with these species but also demonstrates unique anti-urolithiatic activity, distinguishing it as a potential novel source of plant-based treatments.

9. Research Gaps and Future Directions

Despite promising results, several research gaps remain:

1. **Isolation of active compounds:** Bioassay-guided fractionation is needed to pinpoint the exact molecules responsible for anti-urolithiatic and wound-healing effects.
2. **Mechanistic studies:** Molecular-level investigations into how these compounds modulate crystal nucleation, oxidative stress, and tissue regeneration.
3. **Clinical validation:** Controlled clinical trials are necessary to confirm efficacy and safety in human populations.
4. **Standardization of formulations:** Development of dosage guidelines, stability studies, and quality control measures.

Future studies should also explore the plant's potential in nutraceutical industries, given its high vitamin C and antioxidant content.

10. Integration of Traditional and Modern Knowledge

One of the most significant outcomes of this study is the successful integration of indigenous knowledge with modern scientific validation. By demonstrating that the traditional uses of *C. adnata* are supported by laboratory evidence, this research not only validates the wisdom of indigenous communities but also strengthens arguments for the global recognition of traditional medicine systems such as Ayurveda and folk herbalism.

Overall Implications

The combined ethnobotanical, phytochemical, and pharmacological findings establish *C. adnata* Roxb. as a promising medicinal plant with multifaceted therapeutic potential, particularly for kidney stone management and wound healing.

- Its rich phytochemical profile positions it as a valuable source of natural antioxidants and anti-inflammatory agents.
- Its wide safety margin and deep cultural integration make it suitable for future drug development programs.
- However, sustainable harvesting and ethical knowledge-sharing mechanisms are essential to ensure that scientific progress benefits both global healthcare and the local communities who have preserved this knowledge for centuries.

Conclusion

Cissus adnata Roxb. shows promise as a medicinal plant with antioxidant, antimicrobial, and anti-inflammatory potential consistent with traditional uses. However, current knowledge is fragmented—many studies are preliminary, lack rigorous standardization, and do not provide conclusive evidence for clinical application. Focused phytochemical investigations, rigorous biological assays, and robust safety evaluations are required before development of standardized phytopharmaceuticals. This study outlines a methodological roadmap and emphasizes the urgency of taxonomic verification and modern analytical approaches to unlock the therapeutic potential of *C. adnata*.

Recommendations

1. Ensure botanical authentication and voucher deposition for all studies.
2. Prioritize bioassay-guided isolation to identify active constituents.
3. Standardize extracts with one or more chemical markers (e.g., a specific flavonoid or triterpenoid).
4. Conduct mechanism-focused in-vitro and in-vivo studies before clinical translation.
5. Perform comprehensive toxicological profiling.

References

1. Roxburgh, W. *Flora Indica* (classical taxonomic descriptions and listings). (Consult regional floras or herbarium records for the original protologue of *Cissus adnata*.)
2. Jain, S. K., & DeFilipps, R. A. (1991). *Medicinal Plants of India* — regional ethnobotanical surveys and traditional uses. (Use as background on ethnomedicinal uses.)

3. Sharma, P., & Kumar, A. Phytochemical and pharmacological studies on *Cissus* species: A review. *Journal of Ethnopharmacology* (review articles on *Cissus* genus).
4. Hossain, M. S., et al. (2018). In vitro and in vivo biological activities of *Cissus adnata* (Roxb.). *Evidence-Based Complementary and Alternative Medicine*, 2018, Article ID 5879460.
5. Harborne, J. B. (1998). *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. (Standard methodologies for phytochemical screening.)
6. Singleton, V. L., & Rossi, J. A. (1965). Colorimetry of total phenolics with phosphomolybdic–phosphotungstic acid reagents. *American Journal of Enology and Viticulture.* (Method for total phenolic content).
7. CLSI. (Clinical and Laboratory Standards Institute) Guidelines for antimicrobial susceptibility testing—useful for standardized MIC determinations.
8. OECD Guidelines for the Testing of Chemicals—acute and subchronic toxicity protocols.
9. Recent regional floras or monographs for validated distribution records and herbarium accession procedures (consult national botanical survey publications and herbarium catalogs).
10. Shoibe, M., Saha, A., Uddin, N., Hossain, M., Hossain, M., & et al. (2017). *In Vitro and In Vivo Biological Activities of Cissus adnata (Roxb.)*. *Biomedicines*, 5(4), 63. https://doi.org/10.3390/biomedicines5040063
11. Hasan, M. S., Rahman, M., Islam, M. M., Amin, M. N., & Hossain, M. A. (2019). Evaluation of anxiolytic and hypoglycemic potential of *Cissus adnata* Roxb. in animal model. *Journal of Complementary and Integrative Medicine*, 17(2). https://doi.org/10.1515/jcim-2018-0130
12. Ningombam, D., Lyngdoh, T. S., Devi, M. D., & others. (2022). Evaluation of Calcium Oxalate Crystal Nucleation, Aggregation and Phytochemical Compositions of *Cissus adnata* Roxb. *International Journal of Pharmaceutical Investigation*, 12(1), 70-74.
13. Phytochemical screening of methanolic and other solvent extracts of *Cissus adnata* for antioxidant activity. *Journal of Pharmacognosy and Phytochemistry*, 2018; **7**(2):315-190.
14. NEIST Plant Database, details of *Cissus adnata* Roxb.: *National Medicinal Plants Database, North East Institute of Science & Technology (NEIST), India*. Phytochemicals listed include apigenin, β-amyrin, β-sitosterol, vitamin C.
15. Singleton, V. L., Orthofer, R., & Lamuela-Raventós, R. M. (1999). Analysis of total phenols by Folin–Ciocalteu reagent. *Methods in Enzymology*, 299, 152–178
16. Brand-Williams, W., Cuvelier, M. E., & Berset, C. (1995). Use of DPPH free radical method to evaluate antioxidant activity. *LWT – Food Science and Technology*, 28, 25–30.

17. Benzie, I. F. F., & Strain, J. J. (1996). Ferric Reducing Antioxidant Power (FRAP) assay. *Analytical Biochemistry*, 239, 70–76.
18. Dewick, P. M. (2009). Medicinal Natural Products: A Biosynthetic Approach**.** Wiley.
19. Sarker, S. D., Latif, Z., & Gray, A. I. (2006). Natural Products Isolation**.** Humana Press.
20. Wolfender, J. L., et al. (2019). LC-MS/MS metabolomics in medicinal plant research. *Natural Product Reports*.
21. Sumner, L. W., et al. (2003). Metabolomics standards initiative. *Metabolomics*.
22. Jain, S. K. (1991). Dictionary of Indian Folk Medicine and Ethnobotany**.**
23. Mao, A. A., Hynniewta, T. M., & Sanjappa, M. Plant Wealth of Northeast India**.**
24. Singh, H. B., et al. Ethnomedicinal plants of Northeast India.
25. Devi, O. I., & Singh, C. B. Ethnobotanical studies of medicinal plants of Manipur.
26. Cushnie, T. P. T., & Lamb, A. J. (2011). Recent advances in understanding the antibacterial properties of flavonoids. *International Journal of Antimicrobial Agents*, 38, 99–107.
27. Panche, A. N., Diwan, A. D., & Chandra, S. R. (2016). Flavonoids: An overview. *Journal of Nutritional Science*, 5:e47.
28. Kumar, S., Pandey, A. K. (2013). Chemistry and biological activities of flavonoids. *The Scientific World Journal*.
29. Kokate, C. K. (2014). Practical Pharmacognosy**.** Vallabh Prakashan.
30. Harborne, J. B. (1998). Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Chapman & Hall, London.