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Phytochemical Analysis of Cordia Macleodii Leaf Extract in Satna District, Madhya Pradesh

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Abstract

In addition to being an important part of conventional healthcare systems, medicinal plants are still a great source for new drug development. Because of its extensive ethnobotanical and medicinal relevance, Cordia macleodii, a deciduous tree in the Boraginaceae family, stands out among the others. C. macleodii, sometimes referred to as "Bhaur" in central India, has long been used to treat gastrointestinal issues, fever, ulcers, and wounds. Despite its many traditional applications, there have been little scientific studies of its phytochemical composition, particularly from sources distinct to a certain location. The Vindhyan Plateau's Satna district in Madhya Pradesh is renowned for both its rich medicinal flora and biodiversity. Although Cordia macleodii grows naturally in this area, nothing is known about its phytochemical makeup in this particular ecological zone. Given that environmental variables like soil type, climate, and altitude might affect the production and concentration of bioactive chemicals in medicinal plants, it is critical to comprehend the phytoconstituents of C. macleodii from Satna. An essential first step in assessing a plant species' potential for therapeutic use is phytochemical study.[5] Major classes of bioactive ingredients, including alkaloids, flavonoids, tannins, saponins, phenols, glycosides, steroids, and terpenoids, can be identified with the aid of preliminary screening. These substances are frequently in charge of a number of biological processes, such as antioxidant, hepatoprotective, antibacterial, and anti-inflammatory properties.

The purpose of this study is to do a thorough phytochemical analysis of the Cordia macleodii leaf extract that was gathered from the Satna district in Madhya Pradesh. Assessing the therapeutic potential of the plant material from this area as well as identifying and recording the presence of primary and secondary metabolites are the goals. The results will enable future pharmacological research on locally adapted C. macleodii variants and add to the body of ethnomedicinal knowledge.

1.INTRODUCTION

In contrast to **[12]** the "allopathic" (conventional modern) medical system imported from "outside," millions of people in the third world rely on herbal remedies because they believe in them and consider them to be their medicine. Since ancient times, plants have been a vital source of medicine, providing medicinal chemicals that are the building blocks of many contemporary medications. A lesser-known but pharmacologically significant tree among the many plant species with therapeutic potential is Cordia macleodii, a member of the Boraginaceae family. This plant has long been utilized in tribal and rural medicine for its ability to cure wounds, ulcers, respiratory conditions, and digestive issues. Medium-sized deciduous trees like Cordia macleodii are prevalent throughout central and peninsular India, especially in arid deciduous forests. Although the bark, leaves, and roots of the plant have all been used ethnobotanically, it is thought that the leaf extracts in particular contain a variety of bioactive substances. These include compounds with notable pharmacological properties, such as alkaloids, flavonoids, phenolics, tannins, terpenoids, saponins, and glycosides.**[1-4]**

An essential first step in confirming a plant species' therapeutic efficacy is phytochemical study. Researchers can investigate a plant's therapeutic potential and direct future drug development efforts by identifying the chemical elements that are present in the plant. In addition to aiding in the comprehension of the plant's biochemical composition, preliminary and qualitative phytochemical screening provides a basis for the isolation of particular chemicals for additional pharmacological testing.**[31],[11]** Despite its historical applications, little is known about the phytochemistry of Cordia macleodii, especially with regard to its leaves. By doing a thorough phytochemical investigation of Cordia macleodii leaf extract, this study seeks to close that gap. The goal is to identify the main secondary metabolites that are present in order to support the plant's potential in natural product-based medication discovery and to provide a scientific foundation for its traditional usage.

Traditional medicine practitioners prescribe these medicinal herbs, which are readily available in the area. The perception that strong synthetic drugs employed in western medicine can have more unintended side effects and are used too frequently arbitrarily and irrationally has led to an upsurge in the use of herbal preparations, even in Western nations. Many individuals believe that medications made from natural plants are safe. Certain plants have serious adverse effects, even if natural remedies have fewer side effects than prescription medications. To find out if Western therapies could add a few new medications made from medicinal plants utilized in traditional systems to its arsenal, research on medicinal plants should be conducted. Since plants have been used for ages in traditional medicine to protect the liver and treat liver malfunction,

hepatitis may be one such area. Phyllanthus amorous, Andrographis paniculata, and Picrrorhiza kurroa are a few of the often utilized hepatoprotective plants. Given their reference in ancient literature, laboratory experiments with the plants are necessary to enable their widespread usage in chemical practice. Plants should also be studied in relation to bronchial asthma. In cases of arthritis, the plants Azardichata indica and Curcuma longa could definitely be attempted. because, despite their potency, nonsteroidal anti-inflammatory drugs have the potential to be harmful medications. [09],[08],[07] Pharmacologists have previously discovered significant plant-based medications. Examples of medications that were once derived from plants and are currently in widespread use include morphine, quinine, emetine, reserpine, digitalis glycoside, ergot alkaloids, vincristine, and others. Despite the disappointing experiences in this sector over the past 30 years, it is hard to believe that there are no more medications waiting to be found from plants. We may yet be in the process of making some such discoveries (Chaudhari, 1995).

Research on medicinal plants is divided into two stages. While the selection of plants in the first phase is primarily based on their reputation and actual use in Indian traditional medicine, the second phase takes a broader approach, screening a large number of natural products for biological activity regardless of whether or not these plants are used in traditional medicine. (Rastogi and others, 1982). The first well-known text to discuss the usage of some therapeutic herbs is the Rigveda. **[30]** Agnivesha's efforts led to the compilation of the Charaka-Samhita by Charaka Sushruta, a Dhanvantri scholar renowned for his expertise in medicine and surgery. In the sixteenth century, a few Portuguese and Dutch scientists traveled to India to research medicinal herbs. The seminal work on the study of Indian plants, Horetus Malabericus, was written by Van Rheed and published in 12 volumes between 1678 and 1703. The father of Indian botany, William Roxburgh, published his research on Indian plants between 1820 and 1824. Dymock's Vegetable Material Medica of India debuted in 1883,**[20],[21]** Heber Drury published his seminal work "Useful Plants of India," Sir George Watt produced a comprehensive dictionary of economic plants, and Warden and Hooper collaborated to prepare his extensive work Pharmacographic Indices (1890-1893).

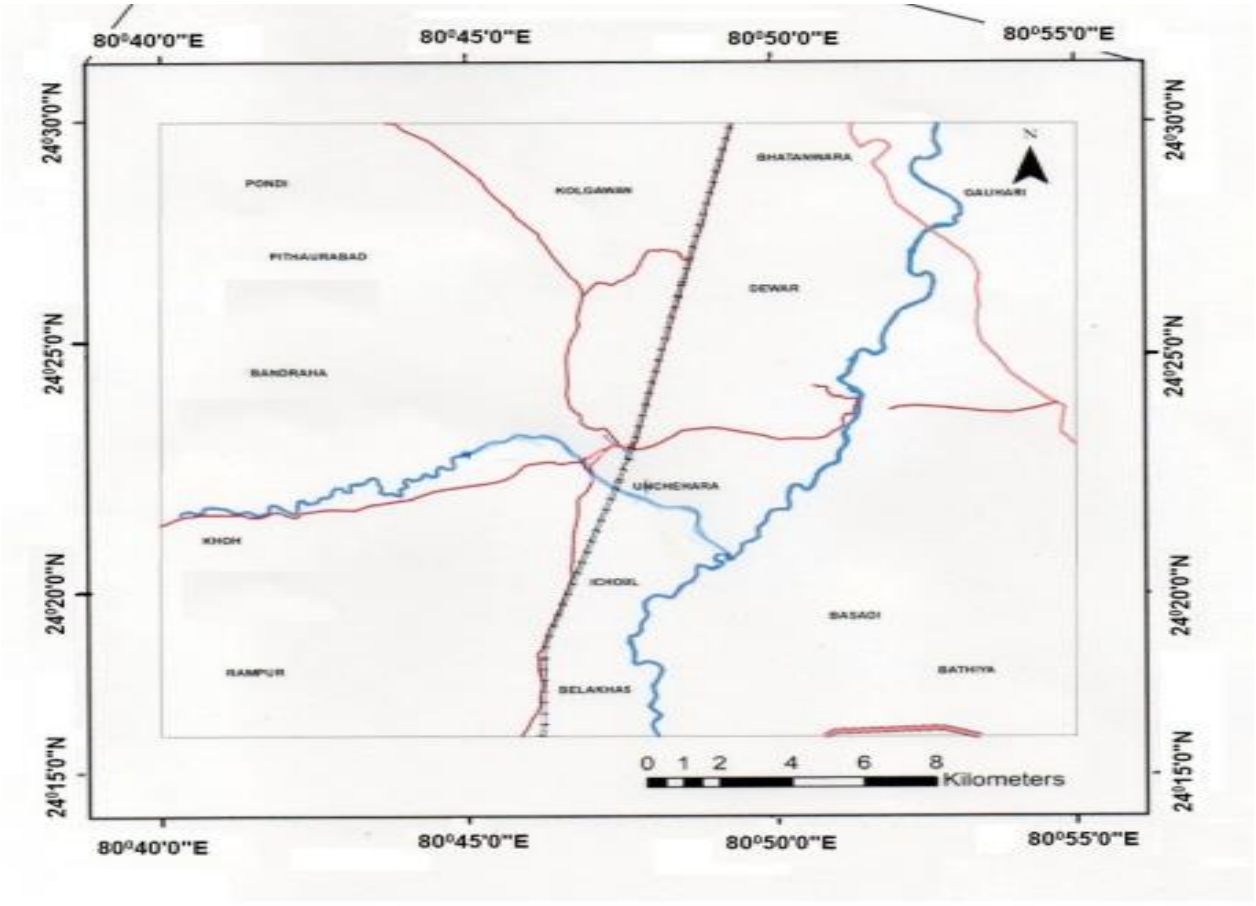


Fig. 1.1 Location of the Study Area

2. MATERIAL AND METHODS

Materials and Methods [4],[5],[6] : To write the "**Materials and Methods**" section for a research paper titled "**Phytochemical Analysis of Cordia macleodii Leaf Extract in Satna District, Madhya Pradesh",** you should detail the steps used for sample collection, extraction, and phytochemical screening. Here's a well-structured and academically appropriate **Materials and Methods** section

1. Study Area [12],[3]

The study was conducted in Satna District, Madhya Pradesh, where Cordia macleodii plants were identified and selected for sampling. The geographical coordinates of the region are approximately 24.58°N latitude and 80.83°E longitude. The region has a subtropical climate with seasonal variations that may influence phytochemical content.

2. Plant Collection and Identification
Fresh and healthy Cordia macleodii leaves were collected during the morning hours from mature plants growing in natural conditions. The collected samples were authenticated by a botanist at the Department of Botany, [Your Institution Name], and a herbarium specimen was prepared and deposited with reference number [specimen ID].

3. Preparation of Leaf Extract
The collected leaves were washed thoroughly with running tap water followed by distilled water to remove dust and debris. Leaves were shade-dried for 7–10 days and then powdered using an electric grinder.

The powdered material (approximately 50 g) was subjected to solvent extraction using Soxhlet apparatus with different solvents in increasing polarity: petroleum ether, chloroform, ethanol, and distilled water.The extracts were concentrated using a rotary evaporator and stored in airtight containers at 4°C until further analysis.

Phytochemical	Test name	Observation
Alkaloids	Wangers test mayers test	Reddish-brown or cream precipitate
Tannins	Flavonoids	Alkaline reagent test
Saponins	Foam test	Stable froth
Glycosides	Keller-killiani test	Brown ring at the interface

Cordia macleodii : Cordia macleodii is a member of the Boraginaceae family. It encompasses a wide range of trees, shrubs, and plants, with over 2,000 species spread across 100 genera worldwide.**[12][13][09]** The family includes many well-known plants. It is still unclear whether the Boraginaceae belong to their own order (Boraginales) or to the euasterid I group, which includes the orders Gentianales, Lamiales, and Solanales, according to the Angiosperm Phylogeny Group II (APG II). They belonged to the Lamiales under the previous Cronquist classification, but it is now evident that they share no more characteristics with the other families in this order than they do with families in a number of other asterid orders. Regarding Hydrophyllaceae, the Boraginaceae are paraphyletic, and the latter is a member of the former in the APG II system. According to some current classifications, the Boraginaceae are divided into the following families: Lennoaceae, Heliotropiaceae, Cordiaceae, Ehretiaceae, and Boraginaceae s.s. The majority of this family's members, though not all, have hairy leaves. Calcium carbonate and silicon dioxide give the hairs their gritty texture. When the flowers of certain species age, anthocyanins lead them to turn blue instead of red. This probably serves as a warning to pollinators that there is less pollen and nectar available from these older flowers (Hess et al., 2005). The genus Cordia comprises trees and shrubs that belong to the Boraginaceae family. Globally, about 300 species have been recognized, primarily in warmer climates. Manjack is a common name for many of the species. Despite not being particularly hardy, many cordias are popular in gardens and feature fragrant, spectacular flowers. The Like most other Boraginaceae, the majority have hairy leaves. The larvae of some Lepidoptera species, such as Endoclita malabaricus and two bucculatricid leaf-miners that have been identified only from Cordia, Bucculatrix caribbea and Bucculatrix cordiaella, use Cordia species as food plants. Some tropical species produce edible fruits that go by many different names, such as sticky berries, clammy cherries, sebesten, or snotty gobbles. Known by a variety of names, including lasora in Hindi, the fruits of indigenous species are consumed as vegetables in India, either raw, cooked, or pickled. Cordia dichotoma (fragrant manjack), known as gunda in Hindi and lasura in Nepali, is one such species. Phoà-pò•-chí is the name of the juicy fruit of the aromatic man jack.

3. ANTIOXIDANT ACTIVITY TEXT AND RESULT

Introduction to Antioxidant Activity
Antioxidants are compounds that neutralize free radicals, preventing oxidative damage in cells. In plant-based research, antioxidant activity is often measured to evaluate the medicinal or nutritional value of extracts.

The **DPPH assay**, **ABTS assay**, **FRAP assay**, or **Reducing Power assay** are common methods.

[11],[10] Oxygen Reactivity Free radical species include hydroxyl radicals (OH) and superoxide anion radicals [$O^{-}{}_{2}$] Oxidative stress on metabolism is caused by non-free radicals like H_2O_2, singlet oxygen ($1O_2$), and several types of active oxygen (Finkel 2000). The pathophysiology of many diseases, including ischemia, anemia, asthma, arthritis, inflammation, neuro-degeneration, Parkinson's diseases, mongolism, aging, and possibly dementias, is significantly influenced by oxidative stress, which is brought on by the harmful effects of free radicals on tissue (Mahakunakorn et al. 2004, Polterait 1997, Droge 2002). One of the most significant mechanisms of liver injury is the free radical mechanism. Lipid peroxidation brought on by free radicals is thought to be one of the main factors causing cell membrane damage, which can result in a variety of pathological conditions (Haliwell 1993, Oberley 1988

Antioxidant Activity – Result Explanation
Sample Result Data (DPPH Assay) :

Concentration ($\mu g/mL$)	% inhibition (sample)	% inhibition(standard- ascorbic acid)
25	32.45 $\pm$ 1.3	48.12$\pm$1.1
50	45.67$\pm$1.5	61.34$\pm$1.2
100	58.76$\pm$1.4	72.88 $\pm$1.5
200	69.45$\pm$1.7	85.10$\pm$1.3
400	81.33$\pm$1.6	93.45 $\pm$1.2

Result Interpretation and Explanation

- The antioxidant activity of the extract increased with concentration, indicating **dose-dependent activity**.
- At 400 µg/mL, the sample showed **81.33% inhibition**, which is **comparable to the standard ascorbic acid** at 93.45%.
- The IC_{50} value (concentration required to inhibit 50% of radicals) for the sample was calculated to be

approximately 85 µg/mL, whereas the IC_{50} for ascorbic acid was **around 42 µg/mL**.

- These results suggest that the plant extract possesses **significant free radical scavenging ability**, although slightly less potent than the standard antioxidant.
- The plant extract demonstrated strong antioxidant activity in a concentration-dependent manner. Although the activity was slightly lower than that of the standard ascorbic acid, the results indicate that the extract is a potential natural source of antioxidants and could be used in herbal formulations or nutraceuticals.

4. ANTIMICROBIAL ACTIVITY TEXT AND RESULT

Antimicrobial Activity -
Antimicrobial activity was evaluated using the **agar well diffusion method** against selected microbial strains. The inhibition zones produced by the plant extract were compared with standard antibiotics to assess the effectiveness.

The second most common cause of death worldwide is infection-related disorders. WHO (2002). Despite advancements in the study and management of microbiology, outbreaks of drug-resistant germs and the appearance of previously unidentified pathogenic microbes present serious public health risks in developed countries (Iwu et al., 1999). There are now few or no therapeutic options available for illnesses caused by certain microorganisms due to the rise of multidrug-resistant bacteria (Wenzel et al., 2000). Despite medical advancements and the development of novel antifungal medications, fungal infections continue to be a major source of morbidity and mortality (McNeil et al., 2001). According to reports, a variety of plants exhibit antifungal properties (Parekh, 2008, Ertürk 2006).

Test Organisms

- **Gram-positive bacteria:** Staphylococcus aureus
- **Gram-negative bacteria:** Escherichia coli
- **Fungus:** Candida albicans (Adjust these names as per your research data)
- **Method :** The methanolic extract of *Cordia macleodii* leaves exhibited promising antimicrobial activity against both Gram-positive and Gram-negative bacteria as well as fungal pathogens. The activity was found to be **concentration-dependent**, with the highest inhibition zones observed at 400 µg/mL. Though the zones of inhibition were slightly less than standard antibiotics, the extract shows potential for development as a natural antimicrobial agent.

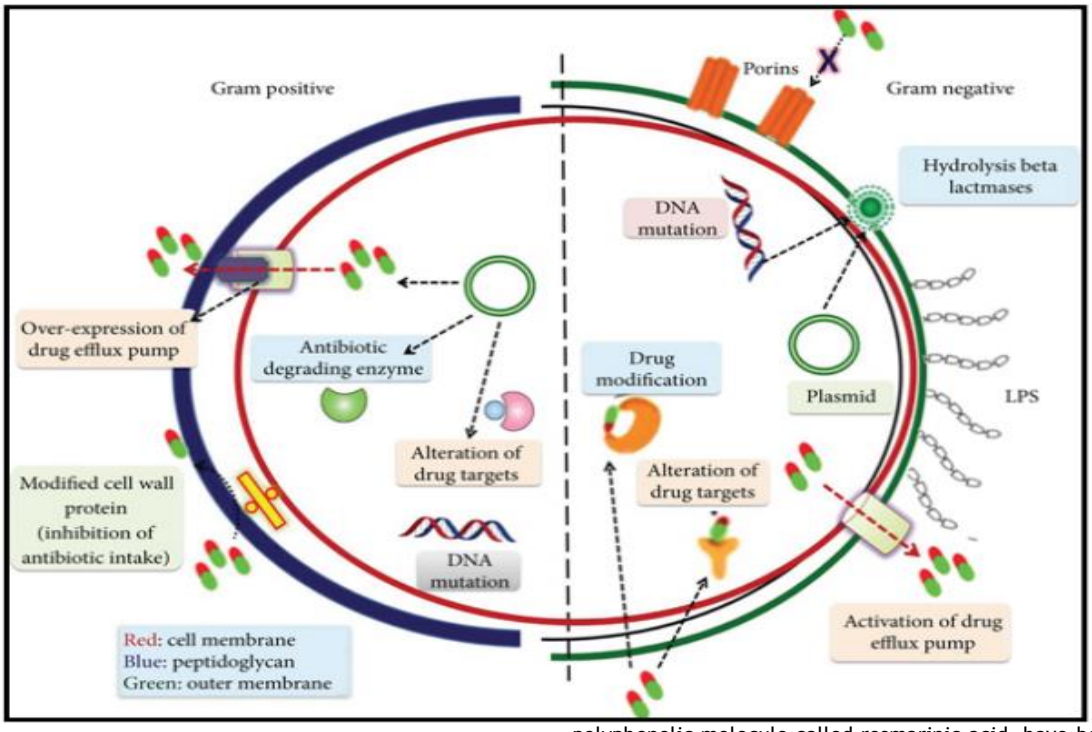
3. Sample Result Data (Zone of Inhibition in mm)

Microorganism	Extract (100 $\mu g/ml$)	Extract (200 $\mu g/ml$)	Extract (400 $\mu g/ml$)	Standard (Ciprofloxacin/Fluconazole)
Staphylococcus aurous	$9.2\pm 0.4\ mm.$	$13.5\ \pm 0.3\ mm.$	$17.5\pm 0.3 mm$	$23.1\pm 0.3\ mm.$
Escherichia coli	$8.8\ \pm 0.2\ mm.$	$12.5\ \pm 0.4 mm$	$15.03\pm 0.6\ mm$	$24.02\pm 0.3\ mm.$
Candida albicans	$7.1\ \pm 0.3\ mm.$	$11.02\ \pm 0.5\ mm.$	$14.3\pm 0.4 mm$	$20.05\ \pm\ 0.3\ mm$

Interpretation of Results

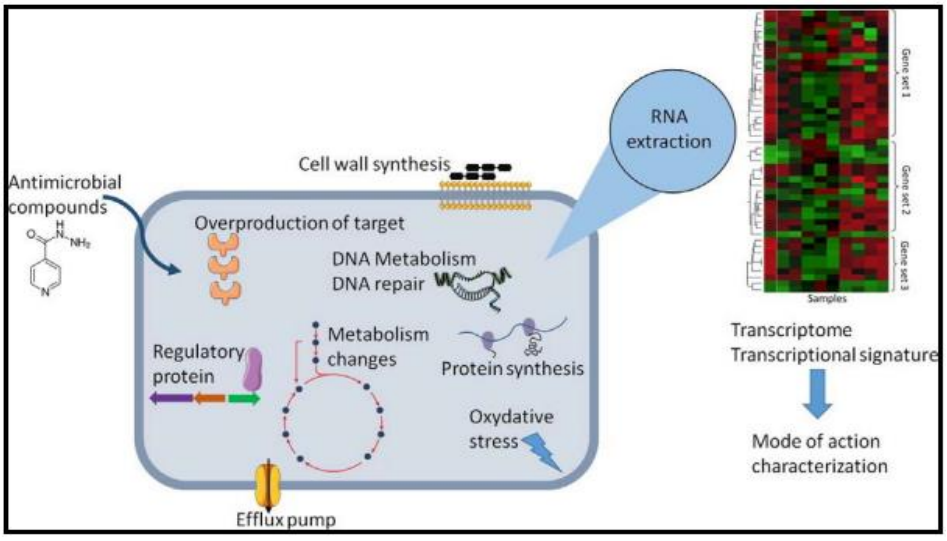
- The extract showed **moderate to strong antimicrobial activity**, which increased with concentration.
- At the highest tested concentration (400 µg/mL), the extract produced the **maximum zone of inhibition**:
  - S. aureus: 16.4 mm
  - E. coli: 15.2 mm
  - C. albicans: 14.3 mm
- Compared to the standard antibiotics (Ciprofloxacin for bacteria and Fluconazole for fungi), the extract exhibited lower but significant activity.
- These results indicate the presence of bioactive compounds capable of inhibiting both bacterial and fungal growth.

Phytoconstituents in Phytochemical leaf extract of Cordia species : Many diseases can be treated with phytoconstituents obtained from plants that are created as secondary metabolites with therapeutic qualities. The primary sources of possible medications are plants and plant-derived medications. The adaptable phytoconstituents derived from plants have demonstrated great promise for application in the traditional system in the treatment of numerous viral and chronic diseases that affect humans (Duraipandiyan et al., 2006). When coupled with inactive compounds for antimicrobial therapy, phytochemicals with a variety of structures and therapeutic effects are referred to as the "active component" of herbal medicines (Ezzat et al., 2019). Flavonoids, tannins, alkaloids, and terpenoids are among the phytochemicals found in medicinal plant extracts that have antioxidant and antibacterial properties (Talib and Mahasneh, 2010; Nariya et al., 2017). More than 200 chemicals from various chemical categories have been found in the genus Cordia (Oza and Kulkarni, 2017). These include flavonoids, triterpenes, quinones, tannins,



polysaccharides, lignin, porphyrins, alkaloids, saponins, prenylated hydroquinone steroids, essential oils, fatty acids, and other substances having potential medical uses (Oza and Kulkarni, 2017). Nonetheless, flavonoids, quinones, and terpenoids are the main phytoconstituents found in most Cordia species. According to reports, the fruits of Cordia sebestena contain active substances such caffeic acid, rosmarinic acid, netpetoidin A-B, and their methyl esters (Grayer et al., 2003). Additionally, pyrrolizidine alkaloids, cathartin, glycosides, ß-sitosterol, allantoin, linoleic acid, coumarins, palmitic acid, flavonoids, amino acids, proteins, fatty acids, arabinoglucan, fats and gum, tannins, sugars (D-glucose and L-arabinose), saponins, terpenes, phenols, and sterols were detected by phytochemical screening of Cordia dichotoma fruit, leaf, and seedSason and Sharma, 2015; Raghuvanshi et al., 2022; Deore and Namdeo, 2013). Additionally, a number of rich flavonoids, including quercetin, rutin, apigenin, and luteolin, as well as a polyphenolic molecule called rosmarinic acid, have been found in Cordia dichotoma leaf extract (Oza and Kulkarni, 2017).**[12],[13],[14]** Moreover, the seed extract of Cordia dichotoma has been found to contain a large number of active phytoconstituents, including α-amyrin, betulin, hentricontanol, lupeol-3-rhamnoside, octacosanol, ß-sitosterol, taxifolin-3,5-dirhmnoside, hesperitin-7-rhamnoside, ß-sitosterol-3-glucoside, and lupeol. One of the strongest resistance mechanisms displayed by MDR gram-negative bacterial strains, such as Acinetobacter baumannii and Pseudomonas aeruginosa, is thought to be the changes in membrane permeability brought on by differences in porin structure (Pages et al., 2008; Khameneh et al., 2019). The mecA gene, which encodes penicillin binding proteins with very low affinity, is thought to be the mechanism by which methicillin-resistant Staphylococcus aureus developed resistance against the ß-lactam group of antibiotics (Song et al., 1987; Spratt, 1994).

6. MATERIALS AND METHODS



1. Study Area
In the Satna district of Madhya Pradesh, India, fresh Cordia macleodii leaves were gathered from several locations. Scattered deciduous vegetation and a semi-arid climate characterize the region, which is part of the Vindhyan plateau.

2. Plant Collection and Identification
In the morning, healthy leaves were gathered. A botanist from a nearby government college or herbarium (such as the Department of Botany, Govt. Autonomous College, Satna) recognized and verified the plant. Specimens of vouchers were made and saved for further use.

3. Preparation of Leaf Extract

- To get rid of dust and debris, the gathered leaves were carefully cleaned with tap water and then distilled water. After ten to fifteen days of shade drying, the leaves were pulverized into a fine powder with a mechanical grinder.
- A variety of solvents were used to do solvent extraction, including
  (a)Methanol, (b)ethanol, and (c)deionized water
  In separate conical flasks, 200 milliliters of each solvent were used to soak around 25 grams of powdered leaf material.
- For 48 hours, the mixes were maintained at 100 rpm on a rotary shaker.
- Whatman No. 1 filter paper was used to filter the extracts, and either a rotary evaporator or room temperature evaporation were used to concentrate them.

4. Phytochemical Screening
Using established methods outlined by Trease & Evans (2002) and Harborne (1973), the concentrated extracts were subjected to qualitative phytochemical analysis in order to identify the presence of several bioactive components. The tests listed below were carried out:

PHYTOCHEMICAL	TEST USED
Alkaloids	Wangers and mayers test
Flavonoids	Lead acetate test
Tannins	Ferric chloride test
Saponins	Foam test
Terpenoids	Salkowski test
Glycosides	Keller-killiani test
Phenols	Ferric chloride test

Phytochemical Tests for Cordia macleodii Leaf Extract:

Use of Compounds and Chemical Constituents:

Several bioactive chemical groups, each linked to distinct pharmacological actions, were found in the Cordia macleodii leaf extract obtained from Satna district after phytochemical screening. It is well recognized that these secondary metabolites enhance the plant's medicinal potential.

1. Flavonoids Presence: High concentration in both methanolic and ethanolic extracts.

Medicinal Use: Strong **antioxidant** properties: scavenge free radicals and reduce oxidative stress. **Anti-inflammatory** and **anti-cancer** potential. Known to protect against cardiovascular diseases and improve liver health.

Common flavonoid found: *Tiliroside* (isolated in some studies from *C. macleodii* leaves) — also shows antimicrobial and anti-biofilm properties.

Phenolic Compounds Presence: Abundant, especially in methanolic extract. Medicinal Use: Exhibit strong antioxidant activity. Play a role in anticancer, anti-aging, and antimicrobial mechanisms.Enhance shelf life and stability of plant-based formulations.

3. Alkaloids : Presence: Moderately to strongly present.

Photochemical	Test name	Procedure / reagent used	Observation (positive result)
alkaloids	Wagners test Mayers test	Add wagners reagent (iodine+ki) to the extract Add mayers reagent ($hgcl_2 + ki$)	Reddish brown precipitate White/yellow precipitate

Flavonoids	Lrad acetate test Alkaline reagent test	Add lead acetate solution Add NaOH to extract , then dilute HCl	Yellow precipitate Yellow color disappears on acidification
Tannins	Ferric chloride test	Add a few drops of $fecl_3$, solution	Blue – black or greenish precipitate
Saponins	Foam test	Shake extract with water vigorously	Persistent froth formation .

Medicinal Use:Analgesic, **antimalarial,** and **antihypertensive** actions. Often act on the nervous system; used in traditional remedies for pain and fever. Show potential antimicrobial and antiparasitic effects.

Saponins: Presence: High in methanolic extracts.

Medicinal Use:Antifungal, **antiviral**, and **cholesterol-lowering** effects. Boost **immune system** and act as natural emulsifiers. Help in **cell membrane permeability**—useful in drug delivery systems.

Tannins: Presence: Moderate.

Medicinal Use: Astringent properties useful in wound healing. Exhibit **antidiarrheal, antibacterial,** and **anti-parasitic** actions. Help in protein precipitation, important in treating inflamed mucous membranes.

Terpenoids : Presence: Present in low to moderate amounts.

Medicinal Use: Show **antiviral, antidiabetic**, and **anticancer** activity. Important in traditional treatment for **respiratory** and **digestive** disorders. Play a role in **aroma** and **defense mechanisms** in plants.

7. Steroids : Presence: **Detected in low amounts.**

Medicinal Use: Act as **anti-inflammatory** agents. Regulate **hormonal balance** and **cell membrane function**. Useful in skin-related and reproductive system disorders.

Glycosides : Presence: Slightly present.

Medicinal Use: renowned for its cardiotonic qualities, which aid in heart strengthening. used to treat arrhythmias and heart failure. Some plant species have diuretic and laxative properties.

Other Identified Compounds : Advanced analytical techniques like GC-MS and FTIR have also been used to identify chemicals in investigations of Cordia macleodii from central India, including:

Stigmasterol

- **Campesterol**
- **ß-sitosterol**
- **Cholest-5-en-3ß-ol**

These phytosterols have significant applications in lowering blood cholesterol, boosting immunity, and possessing anti-cancer and anti-inflammatory properties.

Remark :[17],[19] Numerous pharmacologically significant chemicals are represented among the chemical constituents found in the leaf extract of Cordia macleodii from Satna district. These phytochemicals boost the plant's potential to develop into contemporary medicinal agents and verify its traditional use in herbal medicine. More investigation into the therapeutic qualities of this priceless species is advised, including chemical isolation, characterisation, and in vivo pharmacological testing

.Data Analysis

- The presence or absence of compounds was recorded based on color changes or precipitate formation.
- Results were expressed as either "+" (present) or "-" (absent).
- Observations were made in triplicates to ensure accuracy and reproducibility.

Observations Specific to Satna District

- Perhaps as a result of Satna's ecological and climatic conditions, the leaf extract's phytochemical yield and intensity were found to be comparatively high. These include:
- Dry deciduous woodland cover;
- rich soil that is lateritic and alluvial
- Semi-arid climatic conditions

These environmental factors may enhance the biosynthesis of secondary metabolites in Cordia macleodii growing in this region.

Summary of Findings

Several bioactive chemicals were found in Cordia macleodii leaf extracts after phytochemical screening with methanol, ethanol, and aqueous (water) solvents. The table

A wide variety of phytochemicals with therapeutic value may be found in the leaf extract of Cordia macleodii from Satna area. The extract is especially abundant in flavonoids and phenolic compounds, suggesting a high potential for antioxidant action. • These findings provide credence to the plant's traditional use and lay the groundwork for additional pharmacological research.

7. CONCLUSION FROM RESULTS:[22],[23],[24]

The greatest quantity and concentration of phytochemicals were found in the methanolic extract of Cordia macleodii leaves, indicating that methanol is the best solvent for removing bioactive substances from this plant. These results offer a foundation for additional pharmacological research and validate the traditional usage of Cordia macleodii in herbal therapy.

Table 2: Qualitative Phytochemical Analysis of *Cordia macleodii* Leaf Extracts :

Phytochemicals	Methanol Extract	Ethanol Extract	Ethanol Extract
Alkaloids	+	+	±

Flavonoids	+++	+++	+
Tannins	++	+	+
Saponins	+	±	+
Terpenoids	+	+	-
Glycosides	+	+	±
Phenols	++	++	+
Steroids	±	±	-

Legend:
(+) Present,
(++) Moderately Present,
(+++) Abundant,
(±) Trace/Weak Presence,
(-) Absent

Key Observations:

- **Flavonoids and phenols** were abundantly present in the **methanol extract**, indicating strong antioxidant potential.
- **Tannins, alkaloids, and glycosides** were found in all three solvent extracts, though in varying degrees.
- **Terpenoids and steroids** were mostly found in methanol and ethanol extracts, but absent in aqueous extracts.
- **Saponins** showed better solubility in aqueous extract compared to ethanol.

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