# UNDERGRADUATE RESEARCH INITIATIVES: DOCUMENTATION AND PHYTOCHEMICAL ANALYSIS OF MEDICINAL PLANTS IN THE GREEN CAMPUS OF GURUDAS COLLEGE, KOLKATA

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## Abstract

The green campus of Gurudas College, Kolkata, hosts a diverse collection of medicinal plants, offering a unique opportunity for biodiversity conservation and research. This study documents the medicinal properties of nine significant species: *Azadirachta indica* (neem), *Thuja occidentalis* (thuja), *Costus speciosus* (crepe ginger), *Zamia furfuracea* (zamia), *Achyranthes aspera* (prickly chaff flower), *Durantaerecta* (golden dewdrop), *Carissa carandas* (karonda), *Andrographis paniculata* (king of bitters)mand*Plumeria alba* (white frangipani). These plants are known for their ethnomedicinal value and bioactive phytochemicals. This paper is a part of the Undergraduate Research Initiatives of the college. It was mainly on documentation by undergraduate students whonoted each species' reported phytochemical classes and bioactivities, checked peer-reviewed evidenceand presented summary tables with the guidance of the faculty members. This study was an exercise in training the students to do referencing as well observe the diversity of plants in Gurudas College, Kol-54 campus.

**Keywords:** Documentation, Gurudas College, medicinal plants, bioactive phytochemicals.

## Introduction

Urban and college campus green spaces frequently function as small but valuable reservoirs of medicinal biodiversity and living reference collections for teaching, conservation, and preliminary phytochemical screening [1, 2]. Documenting species, their traditional uses and the scientific literature on their phytochemistry provides baseline data for conservation prioritization, educational programs, and potential bioresource development [3, 4]. Gurudas College green campus houses a set of commonly cultivated medicinal and ornamental species that are also used in local ethnomedicine [5, 6]. (This study integrates field documentation with a targeted literature synthesis of phytochemical classes and reported biological activities for nine focal species present on the campus.

## Materials and Methods

### Field documentation

Species selection was based on (a) prominence on the Gurudas College campus, (b) documented ethnomedicinal use in the Bengal region and broader literature, and (c) taxonomic distinctiveness to cover a broad phytochemical/biological spectrum.

**Literature synthesis**

For each species, we conducted a targeted literature search of peer-reviewed articles, major phytochemical reviews, and species monographs to identify major phytochemical classes and experimentally reported bioactivities. Searches prioritized review articles and recent primary research to ensure comprehensive coverage. Only peer-reviewed sources were included in the reference list.

## Results

### Species accounts: Phytochemical classes and reported Bioactivities

***Azadirachta indica*A. Juss. (Neem)**

*Azadirachta indica*A. Juss.is widely used in traditional systems for antibacterial, antifungal, anti-inflammatory, antidiabetic and anticancer applications. Major phytochemical classes include limonoids (e.g., azadirachtin, nimbolide), triterpenoids, flavonoids (e.g., quercetin), and other phenolics [3]. Pharmacological studies report antioxidant, antimicrobial, anti-inflammatory, antipyretic, hypoglycemic, gastroprotective and chemopreventive actions [3].

***Thuja occidentalis*L. (Thuja)**

*Thuja occidentalis*L. contains essential oils rich in monoterpenes (α- and β-thujone), flavonoids, coumarins, tannins and polysaccharides. Reported bioactivities include antioxidant, anti-inflammatory, antimicrobial (antibacterial/antifungal), antiviral, gastroprotective, radioprotective and potential antitumor effects in preclinical models [2].

***Costus speciosus*(J. Koenig) Sm. (Crepe Ginger)**

*Costus speciosus*(J. Koenig) Sm**.** is a rhizomatous herb used traditionally for fever, cough, inflammation and as a digestive. Phytochemicals include diosgenin and other steroidal saponins, flavonoids, terpenoids and phenolics; these classes underpin reported antioxidant, anti-inflammatory, antidiabetic, and antimicrobial activities [8].

***Zamia furfuracea*L. f. (Zamia)**

*Zamiafurfuracea* L. f.(a cycad) is notable for containing toxic glycosides such as cycasin and azoglucosides and non-protein amino acids (e.g., BMAA) typical of cycads. While cycads are not used extensively in folk medicine because of toxicity, they are ecologically and biochemically notable. Studies on cycads document toxicity (neurotoxic and hepatotoxic potential) and ecological interactions (toxin sequestration by pollinators/herbivores) rather than classical “therapeutic” uses [9].

***Achyranthes aspera*L. (Prickly chaff flower)**

*Achyranthes aspera*L. is used in many traditional systems for wound healing, anti-inflammatory, analgesic and diuretic properties. Major phytochemical classes include alkaloids, saponins, flavonoids, triterpenoids and sterols. Pharmacological reports indicate antimicrobial, anti-inflammatory, antioxidant, antifertility and other activities [10].

***Durantarepens*L. (Duranta)**

*Durantaerecta*L. contains alkaloids, flavonoids, glycosides, phenolics, saponins, steroids, tannins and terpenoids. Reported bioactivities include antimicrobial, antioxidant, insecticidal, and cytotoxic effects. More recent critical reviews also discuss potential toxicities and the need for phytopharmaceutical evaluation [11, 12].

***Carissa carandas*L. (Karonda)**

*Carissa carandas*L. (fruit and leaves) are rich in phenolic acids, flavonoids, anthocyanins, triterpenoids and other polyphenols. Recent profiling reports strong antioxidant and anti-inflammatory activities and evidence for antimicrobial (including anti-urinary-tract infection) properties; LC-MS profiling identifies chlorogenic acid, quercetin glycosides, and anthocyanins as abundant constituents [7].

***Andrographis paniculata*(Burm. f.) Nees (Kalmegh/King of bitters)**

*Andrographis paniculata*(Burm. f.) Nees is characterized by labdane diterpenoids (andrographolide and derivatives), flavonoids and other secondary metabolites. Its reported pharmacology includes broad antiviral, anti-inflammatory, immunomodulatory, antipyretic and hepatoprotective activities; the plant has been widely studied in the context of respiratory infections and as a lead for antiviral drug discovery [4].

***Plumeria alba*L. (White frangipani)**

Species in the *Plumeria group* (including *P. alba*, *P. obtusa* and *P. rubra*) yield iridoids, terpenoids, flavonoids, alkaloids and other phenolics; iridoids in particular are well documented. Reported bioactivities include antimicrobial, antioxidant, anti-inflammatory, wound-healing and cytotoxic effects, though many studies are preliminary and rely on crude extracts [1]

**Discussion**

The nine species present on the Gurudas College green campus represent a cross-section of plant families and phytochemical strategies, limonoid-rich Meliaceae (*A. indica*), terpene-/essential-oil rich Cupressaceae (*T. occidentalis*), labdane diterpenoid-rich Acanthaceae (*A. paniculata*), steroidal saponin-bearing Zingiberales (*C. speciosus*) therefore serve as a useful teaching and research assemblage. The campus collection is particularly valuable because (a) several species have ongoing, modern phytochemical profiling (e.g., *Carissa carandas*) Saeed et al., 2024) and (b) others present important cautionary notes (e.g., cycad toxins in *Zamia*) that are relevant for safe handling and public education (Schneider et al., 2002).

**Table 1 shows theMajor phytochemical classes reported for each species.**

**Table 2. enlists the reported bioactivities from peer-reviewed literature.**

| Scientific Name/common name | Major phytochemical classes |
|---|---|
| *Azadirachta indica* (Neem) | Limonoids (azadirachtin, nimbolide), triterpenoids, flavonoids, phenolics. |
| *Thuja occidentalis* (Thuja) | Essential oils (α/β-thujone), coumarins, flavonoids, tannins, polysaccharides. |
| *Costus speciosus* (Crepe ginger) | Steroidal saponins (diosgenin precursors), terpenoids, flavonoids, phenolics. |
| *Zamia furfuracea* (Zamia) | Cycad glycosides (cycasin), azoglucosides; non-protein amino acids (BMAA). |
| *Achyranthes aspera* (Prickly chaff) | Alkaloids, saponins, flavonoids, triterpenoids, sterols. |
| *Duranta erecta* (Golden dewdrop) | Alkaloids, flavonoids, glycosides, phenolics, saponins, steroids, terpenoids. |
| *Carissa carandas* (Karonda) | Phenolic acids, flavonoids, anthocyanins, triterpenoids, glycosides. |
| *Andrographis paniculata* (King of bitters) | Labdane diterpenoids (andrographolide, neoandrographolide), flavonoids. |
| *Plumeria alba* (White frangipani) | Iridoids, terpenoids, flavonoids, steroidal constituents. |

**Table 2. Reported bioactivities from peer-reviewed literature (representative examples)**

| Species | Representative reported bioactivities |
|---|---|
| *Azadirachta indica* | Antimicrobial, antioxidant, anti-inflammatory, antidiabetic, gastroprotective, anticancer (preclinical). |
| *Thuja occidentalis* | Antioxidant, anti-inflammatory, antimicrobial (antibacterial/fungal), |

| Species | Representative reported bioactivities |
|---|---|
| | antiviral, gastroprotective, radioprotective, antitumor (in vitro/in vivo). |
| *Costus speciosus* | Antioxidant, anti-inflammatory, antidiabetic, antimicrobial; potential steroidal precursor for industrial use. |
| *Zamia furfuracea* | Toxic (cycasin, BMAA): neurotoxic and hepatotoxic effects; ecological toxin-mediated interactions documented. |
| *Achyranthes aspera* | Antimicrobial, anti-inflammatory, antioxidant, antifertility (animal studies), wound healing. |
| *Durantaerecta* | Antimicrobial, antioxidant, insecticidal, cytotoxic; some toxicology reported—warrants caution. |
| *Carissa carandas* | Antioxidant, anti-inflammatory, antimicrobial (incl. urinary pathogens), rich polyphenolic profile. |
| *Andrographis paniculata* | Antiviral, anti-inflammatory, immunomodulatory, hepatoprotective; active diterpenes inhibit viral targets in vitro. |
| *Plumeria* spp. (incl. *P. alba*) | Antimicrobial, antioxidant, anti-inflammatory, wound-healing, insecticidal; many results from extract-level studies. |

**Importance of Conducting Literature Reviews by Undergraduate Students**

Engaging undergraduate students in systematic literature review projects on medicinal plants and phytochemical diversity offers significant academic, scientific, and professional benefits. First, literature review–based research cultivates foundational scientific literacy. By analysing peer-reviewed studies, students learn to evaluate research methodologies, compare results across studies, and identify patterns in phytochemical findings or therapeutic applications. This process strengthens their ability to distinguish between empirical evidence and anecdotal claims, a skill that is especially critical within ethnobotany, pharmacognosy, and plant-based drug discovery [13]. (Letcher, 2020).

Second, such review activities promote early research culture and inquiry-based learning. Undergraduate students often lack access to sophisticated laboratory equipment required for phytochemical extraction or analytical techniques such as HPLC, GC–MS, or LC–MS. Literature reviews provide them with an accessible yet rigorous entry point into research, enabling them to explore global scientific advancements even without laboratory instrumentation. This fosters a mindset of curiosity and evidence-seeking, essential for progression into postgraduate research or scientific careers.

Third, literature reviews help students understand the interdisciplinary nature of medicinal plant studies. Synthesizing information across botany, ethnomedicine, biochemistry, and pharmacology broadens their academic perspective. For example, documenting species on a college campus and analyzing published evidence on their bioactive compounds teaches students how ecology, traditional knowledge, chemistry, and human health are interconnected [14]. (Hernandez et al., 2021). This integrative learning approach prepares students to address complex real-world problems such as biodiversity loss, climate change impacts on medicinal plants, and the global search for novel phytochemical leads.

Fourth, conducting reviews enhances students' academic writing, analytical reasoning, and scientific communication skills. The ability to structure arguments, integrate citations, interpret data, and articulate research gaps are essential competencies valued in academia and the biotechnology, environmental, and pharmaceutical sectors. Students also learn proper APA citation practices, ethical scholarship, and avoidance of plagiarism. These skills contribute to their preparedness for publishing research, writing theses, or applying for competitive research internships and fellowships.

Finally, undergraduate engagement in reviewing medicinal plant literature supports institutional goals of sustainability and biodiversity conservation. When students document species present in campus green spaces, they become active participants in conservation stewardship. Their work can generate baseline datasets, identification catalogues, and localized ethnobotanical knowledge that may be used for campus biodiversity audits or future phytochemical studies [15]. (Singh & Verma, 2019). This empowers students to contribute meaningfully to institutional research outputs while developing a sense of environmental responsibility.

Overall, involving undergraduate students in literature-based research nurtures not only academic competence but also contributes to the broader scientific community. It strengthens the research ecosystem of colleges, builds student confidence, and supports long-term scientific capacity building.

This synthesis highlights a few actionable points for campus managers and researchers:

1. **Conservation &Labeling**: maintain living vouchers with clear labels including family, scientific name, common name and brief note on bioactivity/toxicity (especially for toxic taxa like *Zamia*).
2. **Educational use**: the species cover diverse phytochemical classes and can be integrated into undergraduate practical class (phytochemical screening, simple extraction assays).
3. **Preliminary screening pipeline**: campus material can be the source of preliminary extracts for LC-MS/HPLC fingerprinting and bioactivity screening; however, rigorous standardization and biosafety protocols are required

4. **Research priorities**: species such as *Carissa carandas* and *Andrographis paniculata* have recent high-quality profiling and merit follow-up bioassay-guided isolation; *Duranta* and *Plumeria* require further toxicology and pharmacokinetic work prior to any translational application.

**Limitations**

This paper synthesizes published phytochemical and pharmacological results but does not present new laboratory chemical analyses of the actual Gurudas College specimens. Local chemotype variation, age of plant, and seasonal variation can alter phytochemical profiles; therefore, any attempted bioprospecting from campus specimens should first perform site-specific chemical profiling.

**Conclusion**

The green campus of Gurudas College hosts several medicinally important species whose phytochemistry and bioactivities are well described in the peer-reviewed literature. Integrating the campus collection into formal teaching, conservation, and preliminary phytochemical screening programs is a low-cost, high-impact opportunity. However, careful documentation, specimen-level analysis and adherence to biosafety/ethical guidelines are required prior to any translational exploitation.

**Conflicts of Interest**

The authors declare that there are no conflicts of interest regarding the publication of this work.

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