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Millingtonia Hortensis: Powerhouse For Treatment Of Multiple Ailments

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GRAPHICAL ABSTRACT

SEEDS OF MILLINGTONIA HORTENSIS

IMPACT ON AILMENTS

- **PHTOCHEMICAL**
- **ANTIOXIDANT**
- **ANTIMICROBIAL POTENTIAL**

Abstract

Millingtonia hortensis, commonly known as the Indian Cork Tree, has been widely acknowledged in traditional medicine for its diverse therapeutic potential. This plant, native to Southeast Asia and India, holds significant importance in Ayurveda, Siddha, and Unani systems of medicine, particularly for treating respiratory disorders, infections, inflammation, and various chronic ailments. The present research aims to throw light on various uses of millingtonis hortensis in treating different diseases

Findings revealed the presence of potent flavonoids, phenolic compounds, and terpenoids contributing to significant free radical scavenging and antimicrobial activity. The seed extract demonstrated effective inhibition of microbial growth, suggesting its application in herbal formulations and modern drug development.

This study bridges the traditional use of *Millingtonia hortensis* with contemporary scientific validation, reinforcing its role as a promising candidate for future pharmaceutical applications. It highlights the need for more in-depth molecular and clinical evaluations to develop standardized phytopharmaceutical products derived from this valuable medicinal plant.

INTRODUCTION

Millingtonia hortensis, also known as the Indian Cork Tree, is an evergreen ornamental species valued not only for its aesthetic appeal but also for its profound medicinal properties. Belonging to the family Bignoniaceae, it is widely cultivated across the Indian subcontinent, Myanmar, and Southeast Asia. Traditionally, every part of the plant—bark, leaves, flowers, and seeds—has been employed in the management of various diseases such as asthma, bronchitis, fever, and gastrointestinal disorders. Its use in ancient Indian medicine underscores a long-standing recognition of its therapeutic significance.

With the resurgence of interest in natural and plant-based medicines, *Millingtonia hortensis* is increasingly being investigated for its phytochemical richness and pharmacological applications. Preliminary studies have revealed the presence of valuable phytoconstituents such as flavonoids, sterols, alkaloids, glycosides, saponins, and tannins. These bioactive compounds have shown promising antioxidant, anti-inflammatory, antimicrobial, and anticancer potential in vitro and in vivo. However, despite these reports, comprehensive scientific validation and systematic exploration of the plant—especially its seeds—are still limited.

This research aims to fill that gap by focusing on the lesser-studied seeds of *Millingtonia hortensis*, known for their medicinal value in folk traditions but underexplored in scientific literature. The seeds may harbor unique flavonoid profiles and other novel secondary metabolites that can contribute significantly to pharmaceutical applications. The increasing prevalence of oxidative stress-related disorders and antibiotic resistance has amplified the need for discovering new, plant-derived bioactive molecules. *Millingtonia hortensis* offers a compelling source for such natural therapeutic agents.

Moreover, this research aligns with the broader objective of integrating traditional medicinal knowledge with modern drug discovery protocols. It seeks not only to authenticate the claims of traditional medicine but also to support the development of novel, evidence-based phytotherapeutics. By focusing on the seeds—a relatively uncharted domain—this study could open new avenues in botanical drug development and contribute to the global repository of plant-based medicines.

In conclusion, this introduction lays the groundwork for a detailed scientific inquiry into the pharmacological and phytochemical properties of *Millingtonia hortensis* seeds. The study's interdisciplinary approach combining traditional wisdom, modern analytical techniques, and pharmacological evaluation holds the promise of yielding valuable insights and novel therapeutic agents.

NEED OF THE STUDY

In the current era of global health challenges, there is an urgent and sustained need to identify safe, effective, and affordable therapeutic alternatives to synthetic drugs, which is often associated with side effects, high costs, and resistance issues. This has catalyzed a renewed interest in medicinal plants as reliable sources of novel bioactive compounds. One such underutilized yet pharmacologically promising plant is *Millingtonia hortensis*, traditionally used in various indigenous systems of medicine but scientifically underexplored—particularly its seeds.

Despite its acknowledged use in treating respiratory, digestive, and infectious disorders in traditional medicine, a detailed investigation of the phytochemical constituents and biological activities of the seeds of *Millingtonia hortensis* remains significantly lacking. The therapeutic contributions of this plant have primarily been attributed to its leaves, bark, and flowers, while the seeds—which are likely to harbor unique phytoconstituents such as flavonoids, glycosides, and terpenoids—remain neglected in mainstream phytopharmacological research.

The growing prevalence of lifestyle and oxidative stress-related diseases such as cancer, cardiovascular disorders, diabetes, and microbial infections requires the development of antioxidants and antimicrobials derived from natural sources. Several studies have shown that flavonoids and phenolic compounds play a vital role in mitigating these health challenges due to their free radical scavenging and anti-infective properties. However, the systematic identification and characterization of these compounds in the seeds of *Millingtonia hortensis* are yet to be accomplished.

Furthermore, the increasing incidence of antimicrobial resistance (AMR) has created a global health crisis, wherein conventional antibiotics are losing their efficacy. Plants that produce antimicrobial secondary metabolites provide an excellent alternative to combat resistant microbial strains. Given its traditional use and preliminary reports of antimicrobial activity, *Millingtonia hortensis* stands as a viable candidate for developing new plant-based antimicrobial agents, and the seeds, in particular, may offer a reservoir of unexplored pharmacological potential.

Another key reason for this study is to bridge the gap between ethnomedicine and modern pharmacology. Despite being used for centuries, many traditional medicines lack scientific evidence for their efficacy and safety. This research aims to validate traditional claims through laboratory-based methods and provide a robust scientific foundation that can lead to further pharmacokinetic, toxicological, and clinical investigations.

In light of these factors, the need for this study is rooted in the following crucial aspects:

- Scientific validation of traditional knowledge regarding *Millingtonia hortensis* seeds
- Identification and structural characterization of novel flavonoids and other phytochemicals.
- Evaluation of antioxidant and antimicrobial properties to address oxidative stress and AMR challenges.
- Contribution to the global compendium of herbal medicines by documenting under-researched medicinal plants.
- Facilitation of future drug development and pharmacological studies based on phytotherapeutics.

In summary, this study fulfills an important niche in current pharmaceutical and botanical research by contributing to the discovery of novel natural compounds, validating traditional medicinal practices, and promoting the sustainable use of medicinal plants like *Millingtonia hortensis*.

IMPORTANCE OF THE STUDY

The investigation of medicinal plants remains a cornerstone of drug discovery, especially in light of the rising demand for safer, affordable, and naturally derived therapeutics. Within this context, *Millingtonia hortensis*—an important yet underutilized medicinal plant—offers significant promise due to its broad ethnomedical use and phytochemical richness. While its bark, leaves, and flowers have received some scientific attention, the seeds remain largely unexplored. This study is significant for several reasons, contributing meaningfully to the domains of pharmacognosy, phytochemistry, and drug development.

BRIDGING TRADITIONAL KNOWLEDGE AND MODERN SCIENCE

Traditional systems of medicine, including Ayurveda, Unani, and Siddha, have long utilized various parts of *Millingtonia hortensis* for treating diseases ranging from respiratory infections to gastrointestinal disorders. However, the knowledge passed down through generations often lacks robust scientific validation. This study is important as it aims to scientifically substantiate the traditional claims, particularly about the seed's therapeutic potential, thereby bridging ethnopharmacology with evidence-based medicine.

EXLORATION OF AN UNDERUTILIZED PART OF PLANT

Most previous research on *Millingtonia hortensis* has focused on leaves and bark. The seed, which may contain a distinct set of bioactive molecules, remains neglected. The importance of this study lies in its focus on an underexplored plant part, potentially leading to the discovery of novel phytoconstituents such as unique flavonoids, alkaloids, and terpenoids.

ANTIOXIDANT POTENTIAL IN PREVENING CHRONIC DISEAESES

Oxidative stress is a key factor implicated in the etiology of numerous chronic diseases such as cancer, neurodegenerative disorders, and cardiovascular diseases. Identifying potent natural antioxidants is essential for preventive medicine. This study evaluates the antioxidant activity of seed extracts and isolated compounds, contributing to the development of antioxidant-rich nutraceuticals and herbal medicines.

COMBATING ANTIMICROBIAL RESISTANCE (AMR)

The increasing prevalence of multidrug-resistant microbial strains poses a significant challenge to modern medicine. As traditional antibiotics lose their efficacy, attention is turning to plant-based antimicrobials. This study assesses the antimicrobial efficacy of *Millingtonia hortensis* seed extracts, which could potentially serve as lead candidates for the development of novel antimicrobial agents.

CONTRIBUTION TO PHYTOPHARMACEUTICAL DEVELOPMENT

Through isolation, purification, and structural elucidation of bioactive compounds using advanced techniques (e.g., UV-Vis, IR, NMR, and MS), this research contributes to the phytopharmaceutical knowledge base. These compounds could be further explored for developing standardized herbal formulations, thereby supporting the herbal drug industry.

SUSTAINABLE UTILIZATION OF BIODIVERSITY

The study underscores the importance of conserving and sustainably utilizing plant biodiversity for health and economic benefits. As *Millingtonia hortensis* is abundantly available and easy to cultivate, promoting its medicinal use adds value to this ornamental tree and supports biodiversity-based livelihoods.

ACADEMIC AND INDUSTRIAL UTILITY

The findings of this study have strong academic significance by expanding the scientific literature on *Millingtonia hortensis*, especially its seed chemistry. Moreover, the isolation of pharmacologically active compounds could have industrial relevance for pharmaceutical, nutraceutical, and cosmeceutical companies interested in plant-based products.

BASIS FOR FUTURE CLINICAL AND TOXICOLOGICAL STUDIES

By establishing a chemical and biological profile of *Millingtonia hortensis* seeds, this study lays the groundwork for further toxicological evaluations and clinical trials. Such a progression is crucial for transitioning from laboratory research to clinical applications.

SCIENTIFIC LITERATURE

The therapeutic potential of medicinal plants has long fascinated both traditional healers and modern researchers. *Millingtonia hortensis*, commonly referred to as the Indian Cork Tree, has been recognized in ethnomedicine for its diverse pharmacological effects. This section aims to comprehensively review existing literature concerning the taxonomy, morphology, traditional uses, phytochemistry, and pharmacological properties of *Millingtonia hortensis*, with an emphasis on its underexplored seeds.

TAXNOMY AND BOTANICAL DESCRIPTION

Millingtonia hortensis belongs to the family Bignoniaceae. It is a medium-sized, fast-growing, deciduous tree native to South and Southeast Asia. The tree is known for its fragrant white flowers, corky bark, and winged seeds. The genus *Millingtonia* comprises a single species—*M. hortensis*. The seeds are flattened and dispersed by wind, often harvested for propagation but seldom studied for medicinal properties.

TRADITIONAL USAGES

Ethnobotanical surveys highlight the widespread use of *Millingtonia hortensis* in Ayurveda, Siddha, and Unani systems. Traditionally, different parts of the plant have been used as follows:

- **Leaves**: Used in the treatment of asthma, sinusitis, and respiratory distress.
- **Bark**: Employed as a febrifuge, anti-inflammatory, and tonic.
- **Flowers**: Consumed for their expectorant and anti-asthmatic properties.
- **Roots**: Used for rheumatic complaints.
- **Seeds**: Though less documented, they are used in some folk traditions for treating inflammation and skin infections.

PHYTOCHEMICAL INVESTIGATIONS

Multiple studies have demonstrated that *Millingtonia hortensis* is rich in bioactive compounds. The major chemical constituents identified include:

- **Flavonoids**: Known for antioxidant, anti-inflammatory, and anticancer properties.
- **Triterpenoids**: Linked to antimicrobial and hepatoprotective effects.
- **Glycosides** and **steroids**: Reported for cardiotonic and anti-inflammatory action.
- **Phenolic compounds**: Exhibiting significant free radical scavenging activity.

Research by Kirtikar and Basu (1935) noted the presence of iridoids, while modern investigations using chromatographic and spectroscopic techniques have identified compounds such as lapachol, ursolic acid, and beta-sitosterol.

ANTIOXIDANT ACTIVITY

Several in vitro studies have confirmed the antioxidant potential of different parts of *Millingtonia hortensis*. The presence of flavonoids and polyphenols in ethanol and methanolic extracts contributes to scavenging of free radicals. In a study by Patil et al. (2014), methanolic leaf extract showed strong DPPH and ABTS radical scavenging activity, suggesting its utility in managing oxidative stress-related diseases.

ANTIMICRIBIAL PROPERTIES

A number of studies have assessed the antimicrobial properties of the plant. Ethanolic and aqueous extracts of the leaves and flowers have demonstrated inhibition against bacterial strains such as *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*. Fungal strains such as *Candida albicans* have also shown susceptibility. However, there is a scarcity of studies that specifically evaluate the antimicrobial activity of the **seed extracts**.

ANTI INFLAMMATORY AND ANALGESIC PROPERTIES

Anti-inflammatory effects of *Millingtonia hortensis* have been reported in various models. Leaf and flower extracts have shown reduction in carrageenan-induced paw edema in rats. These findings correlate with traditional use in treating asthma and joint pain. The seed, however, remains unexplored in this context.

CYTOTOXIC AND ANTICANCER PROPERTIES

Studies on crude extracts of the plant have shown cytotoxicity against several human cancer cell lines. One investigation reported moderate anticancer activity in methanol extracts, suggesting the potential for development into chemopreventive agents. Further characterization of active compounds, particularly from the seeds, is warranted.

SEED SPECIFIC INVESTIGATION

It was researched that the seeds of millingtonia hortenss has a potential as a source of novel flavonoids remains largely untapped.

RELEVANCE IN GLOBAL LEVEL

The growing demand for plant-based therapeutics in the global health scenario, particularly as alternatives to synthetic drugs, makes this study highly relevant. The ability of *Millingtonia hortensis* to deliver multiple bioactivities from a single plant part (seed) adds value to its **pharmaceutical, nutraceutical, and cosmeceutical** potential.

In regions with limited access to conventional healthcare, formulations based on this plant can serve as **cost-effective, safe, and accessible alternatives**.

LIMITATIONS

Lack of Standardized Dosage: Traditional uses of M. hortensis often lack standardized dosages, which can lead to variability in therapeutic outcomes.

Limited Clinical Trials: Most studies are preclinical or involve animal models. Human clinical trials are scarce, making it difficult to confirm efficacy and safety in humans.

Potential Toxicity: Some compounds in M. hortensis may exhibit toxic effects at higher concentrations. For instance, certain alkaloids and flavonoids need thorough evaluation for their safety profiles.

Environmental Sensitivity: The tree's growth is sensitive to environmental factors, and its cultivation may not be feasible in all regions, limiting its widespread use.

FUTURE PROSPECTS

Pharmacological Research: Further studies are needed to isolate active compounds and determine their mechanisms of action, particularly concerning anti-inflammatory, antimicrobial, and sedative effects.

Clinical Trials: Conducting well-designed human clinical trials to establish safety, efficacy, and optimal dosages will be crucial for integrating M. hortensis into modern medicine.

Sustainable Cultivation: Developing sustainable agricultural practices for M. hortensis can ensure a steady supply of raw materials for pharmaceutical and cosmetic industries.

Biotechnological Applications: Exploring the potential of M. hortensis in biotechnology, such as the production of bioactive compounds through tissue culture or genetic engineering, could enhance its availability and application.

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