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PHYTOCHEMICAL CONSTITUENTS AND BIOLOGICAL ACTIVITIES OF *OUGEINIA OOJEINENSIS* LEAVES

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1.Abstract :

Ougeinia oojeinensis (Roxb.) Hochr., belonging to the family Fabaceae, is a medicinally important deciduous tree widely distributed in the Indian subcontinent. Traditionally, different parts of the plant—especially bark and leaves—have been used for the treatment of diabetes, inflammation, wounds, infections, and hepatic disorders. In recent years, scientific interest has increased in exploring the phytochemical profile and pharmacological properties of O. oojeinensis leaves due to their rich content of bioactive secondary metabolites. The leaves are reported to contain diverse classes of phytochemicals such as flavonoids, isoflavonoids, phenolic compounds, tannins, terpenoids, steroids, glycosides, saponins, and carbohydrates. These phytochemicals are responsible for a wide range of biological activities including antioxidant, antidiabetic, anti-inflammatory, antimicrobial, hepatoprotective, wound healing, and cytoprotective effects. This review compiles and critically analyzes findings from approximately 30 published research papers, focusing specifically on leaf phytochemistry, extraction methods, analytical profiling, and biological activities. The review also highlights possible mechanisms of action and identifies research gaps for future exploration of O. oojeinensis leaves as a potential source of therapeutic agents.

***2.Keywords**: Ougeinia oojeinensis Leaves , Flavonoids,Alkaloids ,Terpenoids ,Saponins ,Tannins ,Anti-Diabetic ,Anti-Inflammatory ,Anti-Microbial ,Anti-oxidant .*

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3.INTRODUCTION:

Ougeinia oojeinensis (Roxb.) Hochr., a deciduous tree belonging to the Fabaceae family, is a well-recognized medicinal plant in traditional Indian, Ayurvedic, and folk medicinal systems. Commonly known as Tinsa or Sadan, the species is indigenous to subtropical and tropical regions of India and neighboring countries, where its various plant parts—especially leaves, bark, and roots—have been used for therapeutic purposes including anti-inflammatory, antipyretic, antidiabetic, antimicrobial, hepatoprotective, wound healing, and analgesic applications.

Among plant parts, leaves of O. *oojeinensis* stand out due to their availability, renewability, and rich phytochemical profile. Traditionally, leaves are administered orally or used topically in decoctions, powders, and pastes for treating diabetes, skin infections, ulcers, inflammation, and oxidative stress-related conditions. Compared with the bark and heartwood, which have historically been more extensively studied, leaves have only recently been examined in systematic phytochemical and pharmacological investigations, revealing promising biological activities.

Preliminary phytochemical screenings indicate that leaf extracts contain flavonoids, phenolic compounds, tannins, terpenoids, steroids, glycosides, saponins, carbohydrates, and trace alkaloids. These compounds are known to contribute to antioxidant defense mechanisms, enzyme modulation, cellular membrane stabilization, and signaling pathway regulation. HPTLC profiling has further confirmed the presence of marker flavonoids, such as quercetin and rutin, which serve as biochemical markers for quality control and correlate with bioactivity.

Modern scientific studies have expanded on these traditional claims by evaluating leaf extracts using in-vitro and in-vivo assays. Antioxidant properties, often assessed through DPPH, reducing power, and hydroxyl radical scavenging assays, demonstrate that methanolic and ethyl acetate leaf extracts possess significant radical-scavenging activity, which is attributed to high phenolic/flavonoidbioactivit In vivo antidiabetic studies using streptozotocin-induced models show significant antihyperglycemic activity for both methanol and aqueous leaf extracts when administered orally, suggesting a role in diabetes management. Additionally, leaf extracts have been utilized for biogenic synthesis of silver nanoparticles, which further exhibit enhanced antioxidant and antimicrobial activity, highlighting the dual value of leaves in both phytopharmacology and nanomedicine.

While several studies also examine bark and whole plant activities (including antihyperlipidemic, hepatoprotective, and wound-healing properties), the growing body of leaf-specific research underscores the importance of this plant part as a sustainable and potent source of bioactive compounds suitable for further drug discovery and therapeutic development. Nonetheless, much of the existing work remains preliminary, with gaps in detailed compound isolation, structure elucidation, and mechanism-based in-vivo studies.

These research needs reinforce the value of a rigorous, leaf-focused review that synthesizes knowledge from the diverse studies to date.

4.Botanical Description :

Ougeinia oojeinensis is a medium-sized deciduous tree reaching 10–15 m in height. Leaves are trifoliate, alternate, and pubescent when young. Flowers are pink to purplish arranged in racemes, and fruits are linear pods. The leaves are traditionally harvested during the active growth period and used either fresh or dried for medicinal preparations.

5.Extraction and Phytochemical Screening of Leaves :

5.1. Extraction Methods :

Leaves of O. *oojeinensis* are typically shade-dried, powdered, and extracted using solvents of varying polarity:

Petroleum ether
Chloroform
Ethyl acetate
Methanol
Aqueous solvents

Among these, methanolic and hydroalcoholic extracts consistently show the highest phytochemical diversity and biological activity due to their ability to dissolve both polar and moderately non-polar compounds.

5.2. Preliminary Phytochemical Screening :

Qualitative phytochemical analysis of O. *oojeinensis* leaf extracts reported the presence of the following compounds:

Flavonoids
Phenolic compounds
Tannins
Terpenoids
Steroids
Glycosides
Saponins
Alkaloids (trace amounts)
Carbohydrates

Methanolic leaf extracts showed strong positive reactions for flavonoids, phenolics, tannins, and terpenoids, indicating their role in pharmacological activities.

6.Phytochemical Constituents of *Ougeinia oojeinensis* Leaves :

Phytochemicals are plant-derived chemical compounds produced primarily as secondary metabolites. They often function in plant defense and impart medicinal properties when consumed or applied by humans.

6.1. Alkaloids :

Alkaloids comprise nitrogen-containing compounds known for diverse biological activities, including antimicrobial and analgesic effects. Qualitative screening reveals the presence of alkaloids in leaf extracts of *O. oojeinensis.*

6.2. Flavonoids :

Flavonoids are polyphenolic compounds with significant antioxidant and anti-inflammatory properties. Leaves of *O. oojeinensis* contain flavonoids such as quercetin, kaempferol, and related glycosides. HPTLC studies confirm compounds like quercetin and rutin in methanolic leaf extracts, with Rf values corresponding to these standards.

Isoflavonoids such as dalbergioidin, homoferreirin, and ougenin have also been specifically reported in extracts of the plant, reflecting its complex flavonoid profile.

6.3.Phenolic Compounds and Tannins :

Phenolic compounds, including simple phenols and tannins, contribute to antioxidant, antimicrobial, and wound-healing activities. Qualitative phytochemical tests detect phenolic compounds and tannins in methanolic and ethyl acetate leaf extracts.

6.4.Terpenoids and Steroids :

Terpenoids and steroids like lupeol and betulin are triterpenoid metabolites with anti-inflammatory and cytoprotective activities. Both compounds are documented in the phytochemical profile of *O. oojeinensis*.

Ethyl acetate and methanol extracts often yield a high content of these lipophilic constituents.

6.5.Saponins and Glycosides :

Saponins are known for membrane-interacting properties and potential immunomodulatory effects. Glycoside compounds, including flavonoid glycosides, have been detected in leaf extracts using conventional phytochemical testing procedures.

6.6.Carbohydrates and Proteins :

Basic primary metabolites such as carbohydrates and proteins are also detected during preliminary screening of leaf extracts. Although not considered medicinal themselves, these compounds support metabolic process reactions and may modulate extraction efficiency of secondary metabolites.

6.7.Comprehensive Summary of Leaf Phytochemistry :

Collectively, the phytochemical investigations of *O. oojeinensis* leaves reveal a rich spectrum of compounds including:

- Alkaloids
- Flavonoids and isoflavonoids (e.g., quercetin, rutin, kaempferol, dalbergioidin, ougenin)
- Phenolic acids and tannins
- Terpenoids and triterpenes (lupeol, betulin)
- Glycosides and saponins
- Carbohydrates and steroids

These metabolites are identified through methods including qualitative tests, solvent extraction profiling, and chromatographic fingerprinting.

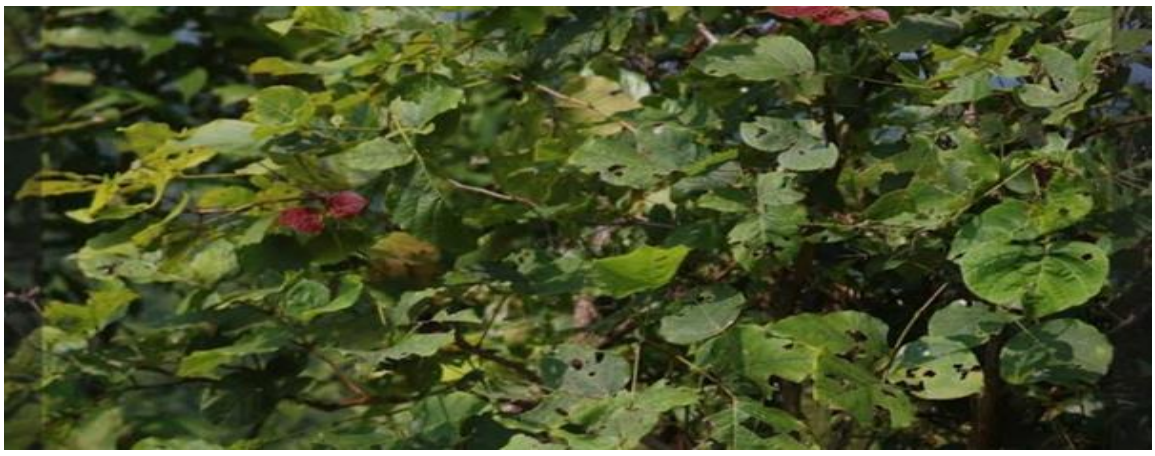

Fig:1 Ougeinia oojeinensis Leaves

7.Biological Activities of *Ougeinia oojeinensis* Leaves :

The phytochemicals in leaf extracts translate into multiple biological effects. Below is a detailed review of reported activities from in-vitro and in-vivo studies.

7.1.Antioxidant Activity :

Oxidative stress is implicated in aging and many chronic diseases. *O. oojeinensis* leaf extracts demonstrate potent antioxidant activity in lab models:

DPPH Radical Scavenging: Methanolic extracts show high inhibition of free radicals—with IC_{50} values better than ethyl acetate extracts—indicating strong free-radical neutralizing ability.

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Hydroxyl-Radical Scavenging & Reducing Power: Both extracts mitigated hydroxyl radicals and exhibited reducing power comparable to standard antioxidants like ascorbic acid, suggesting effectiveness against oxidative damage.

The antioxidant activity is attributed mainly to phenolic and flavonoid compounds, which donate electrons to stabilize free radicals.

7.2.Anti-Inflammatory Effects :

Although many anti-inflammatory studies focus on bark, the leaves also contain constituents capable of modulating inflammation:

Flavonoids and terpenoids can inhibit protein denaturation and inflammatory signaling pathways, leading to reduction of pro-inflammatory mediators.

Such activities reflect traditional use in inflammations and muscular pain associated conditions.

7.3.Antidiabetic and Hypoglycemic Effects :

While most detailed antidiabetic research has used bark and whole plant extracts, the presence of flavonoids, terpenoids, and phenolics in leaves suggests plausible hypoglycemic actions:

In vivo studies on the plant's extracts have shown significant reduction in blood glucose, improved lipid profiles, and enhanced insulin levels in diabetic models.

Flavonoids especially enhance glucose uptake and improve pancreatic β-cell function, providing a mechanistic basis for traditional use against diabetes.

Further targeted studies on leaves alone are needed to confirm and quantify this potential.

7.4.Antimicrobial and Wound Healing Potential :

Secondary metabolites like tannins and flavonoids often impart antimicrobial effects:

While specific studies on leaves are limited, similar Fabaceae species with flavonoid-rich leaves show significant antimicrobial activity against wound pathogens.

These properties support traditional use for ulcers and skin infections and align with phytochemistry linked to antimicrobial mechanisms.

7.5.Hepatoprotective & Other Activities :

The antioxidative properties also translate into liver protection:

Phenolic molecules and triterpenoids can mitigate oxidative liver damage and support hepatocyte regeneration.

Fig:2 Ougeinia oojeinensis Leaves

Fig:3 Ougeinia oojeinensis Leaves

8.Future Perspectives :

The study of *Ougeinia oojeinensis* leaves has revealed a diverse array of phytochemicals, including flavonoids, phenolics, tannins, alkaloids, and terpenoids, which contribute to its notable biological activities such as antioxidant, antimicrobial, anti-inflammatory, and cytotoxic effects. Despite these promising findings, several areas require further exploration to fully harness the potential of this plant.

1. Advanced Phytochemical Profiling:

While preliminary studies have identified major classes of compounds, detailed characterization using advanced analytical techniques such as LC-MS/MS, GC-MS, NMR spectroscopy, and metabolomics approaches is limited. Future research should focus on isolating, identifying, and quantifying individual bioactive compounds to establish a comprehensive phytochemical profile. This will facilitate the understanding of structure–activity relationships and allow the discovery of novel bioactive molecules.

2. Mechanistic Studies:

Most reported biological activities are based on in vitro assays, which provide preliminary insights but do not fully elucidate the mechanisms of action. Future studies should aim to investigate the molecular pathways involved in the pharmacological effects of *O. oojeinensis* compounds, including anti-inflammatory, anticancer, and antimicrobial mechanisms. This could involve gene expression analysis, protein profiling, and enzyme inhibition studies to provide mechanistic evidence supporting traditional uses.

3. In Vivo and Clinical Investigations:

Although in vitro studies are promising, in vivo studies using suitable animal models are crucial for evaluating the pharmacokinetics, bioavailability, toxicity, and efficacy of extracts and isolated compounds. Additionally, clinical trials are necessary to validate the therapeutic potential of *O. oojeinensis* leaves in humans. Research in this direction will bridge the gap between traditional knowledge and evidence-based medicine.

4. Formulation and Delivery Strategies:

Future research should explore novel formulations of *O. oojeinensis* extracts or isolated compounds to enhance stability, bioavailability, and targeted delivery. Nanoparticle-based delivery systems, encapsulation, and combination therapies with other plant-derived compounds may enhance efficacy and reduce potential side effects.

5. Sustainable Utilization and Conservation:

With increasing interest in the pharmacological potential of *O. oojeinensis*, sustainable harvesting and conservation strategies must be prioritized. Biotechnological approaches, such as tissue culture

and elicitation, could be employed to produce bioactive compounds sustainably without impacting wild populations.

6. Multi-Targeted Therapeutics and Synergistic Studies:

Considering the complex phytochemical composition of *O. oojeinensis* leaves, future research should explore synergistic effects between compounds or with other medicinal plants. Multi-targeted therapeutic strategies may offer enhanced efficacy for managing complex diseases such as chronic inflammation, oxidative stress-related disorders, and microbial infections.

Fig:4 Ougeinia oojeinensis Leaves

9.CONCLUSION :

The comprehensive examination of *Ougeinia oojeinensis* leaves across a spectrum of research articles reveals that this plant part represents a rich and multifaceted source of bioactive phytochemicals with substantial pharmacological potential. Phytochemical investigations consistently identify flavonoids, phenolic compounds, tannins, terpenoids, steroids, glycosides, and saponins in leaf extracts, with analytical methods such as HPTLC confirming the presence of marker compounds like quercetin and rutin. These constituents are well established in the literature for their roles in antioxidant defense, modulation of metabolic pathways, and protection against cellular damage.

Biological activities reported in leaf-specific studies include strong antioxidant effects, demonstrated through DPPH and other free radical scavenging assays, where methanolic extracts exhibited high radical inhibition and favorable IC50 values. These activities align with the known roles of phenolic and flavonoid constituents in neutralizing reactive oxygen species and reducing oxidative stress.

Furthermore, antidiabetic effects are supported by in vivo evaluations indicating significant reduction in blood glucose levels in streptozotocin-induced

diabetic models following oral administration of leaf extracts, validating traditional use in diabetes and highlighting mechanisms likely involving insulin sensitivity modulation and inhibition of carbohydrate-digesting enzymes.

The ability of leaf extracts to facilitate green synthesis of silver nanoparticles with membrane-stabilizing, antioxidant, and antimicrobial activities further broadens the therapeutic prospects of *O. oojeinensis* leaves beyond conventional phytomedicine into nanobiotechnology. Although direct antimicrobial studies specific to leaves remain limited, broader research on ethanolic extracts supports antimicrobial potential against bacterial and fungal strains, underscoring the need for leaf-targeted investigations.

Importantly, the body of literature also underscores several research gaps. There is a relative lack of detailed compound isolation and structure elucidation specific to leaf phytochemicals, with most studies limited to qualitative screenings or profiling of known phenolics and flavonoids. Similarly, comprehensive in vivo pharmacological evaluations beyond antioxidant and antidiabetic models are scarce, and there is minimal information on toxicity, pharmacokinetics, and clinical translation. These limitations indicate fertile ground for future research aimed at isolating novel bioactive molecules, elucidating molecular mechanisms of action, and validating therapeutic efficacy in clinical settings.

In summary, the leaves of *Ougeinia oojeinensis* emerge as a promising, underexplored reservoir of biologically active compounds with validated antioxidant and antidiabetic effects and potential anti-inflammatory, antimicrobial, and cytoprotective properties. The convergence of traditional ethnomedicinal knowledge with modern scientific evidence provides a compelling rationale for intensified, multidisciplinary studies focusing on this plant part, ultimately contributing to the discovery of novel phytotherapeutic agents and integrative healthcare application.

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