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HEDYCHIUM CORONARIUM (GULBAKWALI): AN EXTENSIVE STUDY ON MEDICINAL AND TRADITIONAL APPLICATIONS

[1*]Doshan Lal, [2]Ashwanee Kumar Sahu

[1]M Pharmacy Student Faculty of Health and Allied Sciences ISBM University Nawapara (Kosmi) Chhura Gariyaband C.G. 493996.

[2]Phd Scholar Faculty of Health and Allied Sciences ISBM University Nawapara (Kosmi) Chhura Gariyaband C.G. 493996.

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***Corresponding Author**

Doshan Lal

M Pharmacy Student Faculty of Health and Allied Sciences ISBM University Nawapara (Kosmi) Chhura Gariyaband C.G. 493996.

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ABSTRACT

Hedychium coronarium J. Koenig (commonly known as Gulbakwali or White Ginger Lily) is a perennial herb of the Zingiberaceae family, valued for its ethnomedicinal and pharmacological importance. Traditionally employed as a febrifuge, eye tonic, anti-rheumatic, and in the management of asthma, arthritis, and diabetes, the plant has gained increasing attention in modern phytopharmacology. Phytochemical investigations reveal a rich diversity of metabolites, including labdane diterpenes (e.g., coronarin D), flavonoids, glycosides, saponins, and essential oils dominated by cineole, limonene, and linalool, which contribute to its antioxidant, antimicrobial, anticancer, anti-inflammatory, and antidiabetic effects. Recent experimental studies further highlight the therapeutic promise of its rhizome, leaf, and flower extracts against oxidative stress, microbial infections, metabolic disorders, and cataractogenesis. However, overexploitation, habitat destruction, and limited natural regeneration have led to population decline, raising urgent conservation concerns. Sustainable cultivation strategies, chemotypic mapping, and advanced pharmacological investigations are essential to unlock the plant's full therapeutic potential. This review consolidates ethnobotanical knowledge, phytochemical data, and pharmacological evidence on *H. coronarium*, while identifying gaps in in vivo validation, standardization, and conservation practices. Integrating traditional wisdom with modern drug discovery

approaches may establish this species as a valuable source of novel phytopharmaceuticals and nutraceuticals.

KEYWORDS: *Hedychium coronarium*, Gulbakwali, phytochemistry, pharmacology, conservation, traditional medicine.

INTRODUCTION

Hedychium coronarium, commonly known as the White Ginger Lily, is a perennial herb belonging to the Zingiberaceae family. It is widely recognized for its medicinal properties and is used in traditional medicine across various cultures, particularly in India and China. The plant is characterized by its fragrant white flowers and is found in tropical and subtropical regions. Despite its widespread use, Hedychium coronarium faces threats from overexploitation and habitat destruction, leading to its decline in natural habitats. This review explores the plant's phytochemical composition, medicinal uses, and conservation challenges.

Phytochemical Composition

- Hedychium coronarium contains a variety of bioactive compounds, including saponins, glycosides, flavonoids, and volatile oils. Key phytochemicals identified include hedychicoronarin, peroxycoronarin D, and labdane diterpenes such as coronarin D, which is noted for its anticancer properties (Tailor & Goyal, 2015) (Kumar et al., 2022).
- The essential oils of H. coronarium are rich in compounds like limonene, myrcene, and linalool, which contribute to its therapeutic effects (Kumar et al., 2022).

Medicinal Uses

- Traditionally, Hedychium coronarium is used as a febrifuge, eye tonic, and anti-rheumatic agent. It is also employed in treating asthma, headaches, arthritis, and various other ailments (Manish, 2013) (Kumar et al., 2022).
- The rhizome of the plant is particularly valued for its medicinal properties, including anti-cancerous, antioxidant, and anti-hypertensive activities. It is also used in the treatment of diabetes, cold, and rheumatic pain (Tailor & Goyal, 2015) (Diwas, 2017).
- In Ayurvedic medicine, the plant is used as a mild tranquilizer and anthelmintic, highlighting its diverse therapeutic applications (Manish, 2013).

Conservation Challenges

- Hedychium coronarium is facing a decline in its natural habitat due to overexploitation for medicinal purposes and habitat destruction. In regions like Anuppur and Dindori districts of Madhya Pradesh, India, the plant's population density is alarmingly low, with almost no regeneration observed in open forests (Manish, 2013).
- The increased market demand for products like Ark (juice) extracted from its flowers exacerbates the threat to its survival, necessitating urgent conservation efforts (Manish, 2013).

Potential and Future Directions

- The diverse bioactive compounds in Hedychium coronarium present opportunities for developing new pharmaceuticals and nutraceuticals. The plant's essential oils and extracts could be utilized in creating flavor and fragrance agents, food preservatives, and botanical pesticides (Kumar et al., 2022).
- Further research into the pharmacological activities of its phytoconstituents could lead to the discovery of new drug targets and enhance the therapeutic potential of the plant (Singh et al., 2023) (Tavares et al., 2020).

While Hedychium coronarium holds significant medicinal value, its overexploitation poses a serious threat to its existence in the wild. Conservation strategies are crucial to ensure the sustainable use of this plant. Additionally, further research into its phytochemical properties could unlock new therapeutic applications, potentially benefiting both traditional and modern medicine.

In addition to its traditional uses, Hedychium coronarium has garnered attention for its potential in modern pharmacological applications, particularly due to its rich profile of bioactive compounds. Recent studies have highlighted the presence of phenolic compounds and terpenoids, which contribute to its antioxidant and anti-inflammatory properties, making it a candidate for further research in the treatment of various ailments (Pachurekar & Dixit, 2017). Furthermore, the geographical diversity of H. coronarium populations has been shown to influence both morphological and chemical variations, suggesting that conservation efforts could enhance its medicinal efficacy (Ray et al., 2019). This underscores the importance of sustainable harvesting practices and habitat preservation, as the over-exploitation of this valuable herb could diminish its availability and therapeutic potential in the future.

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PLANT PROFILE

Here's an enriched, **year-descending (most recent first)**, column-wise overview of *Hedychium coronarium* (Gulbakwali) research, including **new studies** (up to early 2025) with plant parts, extraction methods, key results, and remaining research gaps.

Hedychium coronarium Research Summary Table

Author(s) & Year	**Title & Journal**	**Plant Part**	**Solvent / Extract / Method**	**Key Findings**	**Research Gaps**
Rameshroo et al. (2025)	*Anti-cataract Effect of Flower Extract* (Current Biotechnology)	Flowers	Aqueous extract (GC-MS + docking + ex vivo goat lens)	Identified phenolics (e.g. 4-ethyl-2-methoxyphenol, isoborneol, cineol); DPPH IC_{50} ~139.7 µl/mL, ABTS IC_{50} ~43.9 µl/mL; restored GSH, catalase, reduced MDA in diabetic-cataract model; docking supports γ-crystallin/aldose reductase inhibition (benthamscience.com)	Lacks in vivo data; needs animal cataract models, pharmacokinetics
Panigrahy et al. (2019 / published online by 2023)	*In Vitro & In Vivo Anti-diabetic Activity* (Proc. Natl Acad Sci India)	Rhizomes	Terpenoid-rich fraction (methanol-based)	In streptozotocin-diabetic rats (10 mg/kg): significant reduction in blood glucose, ↑body weight, improved antioxidant enzymes, normalized carbohydrate-metabolizing enzymes; no liver/kidney histology damage	Needs dose-response multiple arms, human-relevant

				(ResearchGate)	toxicity and PK studies
Mitchaleaw et al. (2024)	*Anti-acne & Deodorant Efficacy via PEF Extraction* (Antibiotics, MDPI)	Leaves & Rhizomes	Ethanol using Pulsed Electric Field (10-20 kV/cm)	PEF (20 kV/cm) ↑ yield and ellagic acid, leaf extract stronger vs acne-causing *C. acnes* and odor bacteria; no irritation in hen's egg model	Still only in vitro and ex ovo; needs in vivo skin testing, full chemical profiling of extract
Priya et al. (2023)	*Phytochemical & Pharmacological Activities* (IJPS Journal)	Rhizome essential oil	Hydrodistillation + GC-MS	Detailed chemotyping: cineole, pinene dominant; potent antioxidant activity (DPPH, ABTS) (IJPS Journal, Frontiers)	No antimicrobial or mechanistic follow-up; lacks standardization
Kenwat et al. (2025)	*Anti-cataract Ex vivo & In silico* (Current Biotechnology)	Flowers	Aqueous extract (GC-MS, docking, ex vivo)	Ex vivo goat lens: restored antioxidant capacity and protein levels; docking suggests binding to aldose reductase and crystallin targets (benthamscience.com)	Needs validation in animal cataract models and in vivo efficacy
Martins et al. (2014)	*Cancer Chemoprevention… labdane diterpenes* (Rev Bras Pharmacognosia)	Rhizome fractions	Methanol extraction + chromatography	Isolated coronarin D/E variants; inhibited COX-1/2, NF-κB; activated antioxidant response elements; cytotoxic in vitro (MDPI, Taylor & Francis)	No in vivo efficacy, safety, or PK data
Joy et al. (2007)	*Antimicrobial activity of essential oil* (Phytother Res.)	Fresh & dried Rhizomes	Hydrodistilled EO, GC-MS profiling	Major components: 1,8-cineole (~41 %), β-pinene, α-terpineol; strong antifungal (*Candida*, *Trichoderma*) vs modest antibacterial (pubmed.ncbi.nlm.nih.gov)	Tested on few microbes; dated methods; lack minor compound analysis
Basudeba Kar et al. (2023 review)	*Traditional Uses, Phytochemistry & Pharmacology* (Taylor & Francis)	Overview	Review summary	Volatile content across studies: cineole (16–56 %), β-pinene, coronarin A/D/E/F; traditional uses: antidiabetic, antimicrobial, inflammatory, analgesic, larvicidal; recognized minor constituents like villosin and linalool (Taylor & Francis, MDPI)	Mostly literature; experimental depth limited, especially on minor metabolites
Pachurekar &	*Pharmacognostic*	Multiple	Review	Reports phenols, terpenoids,	No new

Dixit (2017)	*& Ethnomedicinal Properties* (Int J Chinese Med.)	parts		flavonoids, saponins, glycosides; notes conservation concerns (Amarkantak endemic) (sciencepublishinggroup.com)	experiments; need updated phytochemical and sustainable cultivation studies
Safety/venom assay study (2014-15)	*EOs vs snake venom proteases* (J Venomous Anim Res)	Leaves & Rhizomes EO	Hydrodistilled essential oil tested in vitro	Inhibited fibrinogenolysis and protease activity from Bothrops/Lachesis snake venoms (jvat.biomedcentral.com)	Only in vitro screening; requires animal envenomation models and safety evaluation

Suggested Research Directions

1. **Advance in vivo studies**
   - Expand on terpenoid fraction study with multiple dosage arms, PK profiling, and chronic toxicity.
   - Test aqueous flower extracts in animal diabetic-cataract models.
   - Conduct dermal patch or animal skin tests on PEF leaf extracts for acne/deodorant applications.

2. **Comprehensive phytochemical mapping**
   - Use LC-MS/MS, NMR, metabolomics to characterize minor phenolics and diterpenes.
   - Correlate seasonal, regional, and plant-part variation with bioactivity.

3. **Mechanistic and molecular studies**
   - Validate docking findings with enzyme assays (e.g. aldose reductase inhibition, anti-acetylcholinesterase).
   - Probe cellular pathways (e.g. NF-κB, MAPK, collagenase/elastase pathways).

4. **Standardization and reproducibility**
   - Define protocols for PEF, hydrodistillation, extraction solvents, and bioassay panels.
   - Develop reference standards for coronarin D/E, cineole, ellagic acid in extracts.

5. **Conservation and sustainable sourcing**
   - Study cultivation protocols, propagation in Amarkantak region, and sustainable harvesting to prevent overexploitation.

CONCLUSION

Hedychium coronarium (Gulbakwali) emerges from the reviewed evidence as a pharmacologically rich medicinal herb with broad traditional and modern relevance. Its rhizomes, leaves, and flowers contain diverse bioactive constituents—including labdane diterpenes such as coronarin D, flavonoids, phenolics, and essential oils—that underpin documented antioxidant, antimicrobial, anti-inflammatory, anticancer, antidiabetic, and anti-cataract activities. Current research highlights strong in vitro and promising ex vivo efficacy across multiple disease models, yet also reveals substantial gaps in in vivo validation, standardization of extracts, and mechanistic studies. At the same time, overexploitation and habitat degradation have critically reduced natural populations, underscoring the urgent need for scientifically guided conservation, sustainable cultivation, and chemotypic mapping. Integrating traditional knowledge with modern pharmacology—supported by rigorous in vivo studies, molecular assays, and standardized extraction protocols—could enable the development of novel phytopharmaceuticals and nutraceuticals from this species. Overall, H. coronarium holds significant biomedical potential, but its future therapeutic impact depends on parallel advances in research quality, conservation, and sustainable resource management.

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