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Phytochemical study and antioxidant activity of *Ceriscoides turgida* (Roxb.) Tirveng. Root: A review

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Abstract
Ceriscoides turgida (Roxb.) Tirveng. (syn. *Gardenia turgida*), a prominent member of the Rubiaceae family, is a deciduous medicinal tree traditionally valued across the Indian subcontinent for its diverse therapeutic properties. This review synthesizes current knowledge regarding the phytochemical profile, extraction methodologies, and biological activities of *C. turgida* roots. Phytochemical investigations reveal a rich reservoir of secondary metabolites, including triterpenoids, saponins, flavonoids, and phenolics. Comparative analysis of extraction techniques indicates that Soxhlet extraction using polar solvents like methanol provides superior yields of these metabolites compared to cold maceration, although maceration better preserves heat-sensitive antioxidants.

Furthermore, the root exhibits significant antibacterial efficacy against pathogens such as *Escherichia coli* and *Staphylococcus aureus*, validating its ethnobotanical use in treating infectious diarrhea and wounds. This review concludes that the synergistic effect of its antioxidant and antimicrobial constituents' positions *C. turgida* as a promising candidate for the development of natural phytopharmaceuticals.

Keywords: *Ceriscoides turgida*, sohxlet extraction, phytochemical screening, antioxidant activity, antibacterial potential

Introduction

Ceriscoides turgida, commonly known as "Mountain Gardenia" or "Kharhar," is distributed across the Indian Subcontinent and Southeast Asia (Tirvengadum, D. D., 1978) [10]. Ethanobotanical surveys indicate that tribal communities in India particularly in Chhattisgarh and Maharashtra use root decoctions for childhood indigestion, jaundice, and as an antidote for snake bites (Zilani *et al*., 2017) [4]. Recent pharmacological interest has shifted toward its antioxidant properties as a mechanism for its diverse therapeutic claims.

Extraction Methodologies: Sohxlet vs. Maceration

The efficiency of isolating bioactive compounds from the dense, woody root of *C. turgida* is significantly influenced by the extraction technique and solvent polarity.

1. Sohxlet Extraction (Hot Continuous Extraction)

Sohxlet extraction is preferred for the exhaustive exhaustion of the root matrix.

1. **Process:** Powdered root (typically 30g) is placed in a thimble and extracted with solvents (petroleum ether, chloroform, ethyl acetate, acetone, and methanol) for 48–72 hours Mallik, J. *et al*., 2012) [7].
2. **Yield:** Methanol consistently provides the highest extractive value (2.61 %), as the heat facilitates the solubility of polar phenolics and alkaloids that are otherwise trapped in the fibrous root tissues.
3. **Advantage:** High efficiency and reduced solvent consumption through continuous recycling.

2. Maceration (Cold Extraction)

- **Process:** Involves soaking the root powder in a solvent (often 80% ethanol or methanol) at room temperature with periodic agitation for 3–7 days. (NR Ozarkar., 2005) [8]
- **Observation:** While maceration is gentler and prevents the thermal degradation of delicate flavonoids, it often results in lower yields for *C. turgida* roots due to the poor penetration of the cold solvent into the lignified root cells compared to hot Soxhlet cycles.

Phytochemical Profile

The phytochemical diversity of C. turgida roots is highly dependent on solvent polarity. Methanolic and ethanolic extracts yield the highest concentrations of bioactive compounds.

1. **Quantitative Markers:** Studies have shown that the root extract contains a significantly higher concentration of phenolics and flavonoids compared to its leaves. Typical values reported include:
   - **Total Phenolic Content (TPC):** ≈79.99 mg GAE/g dry extract (Zilani *et al*., 2017) [4].
   - **Total Flavonoid Content (TFC):** ≈35.27 mg QE/g dry extract.
2. **Qualitative Screening:** Preliminary investigations confirm the presence of:
   - **Triterpenoids and Sterols:** Including β-sitosterol and oleanane-derivatives.
   - **Saponins and Tannins:** Identified via Froth and Ferric Chloride tests respectively. (Joshi, K. C., & Sharma, T.,1975) [5]
   - **Iridoids:** Common to the Rubiaceae family, contributing to the bitter therapeutic profile.

Antioxidant Activity

The root demonstrates potent antioxidant activity, primarily through hydrogen-atom transfer and electron-donation mechanisms.

1. **DPPH Radical Scavenging**

The methanol root extract exhibits a dose-dependent inhibition of the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical. Research indicates an IC50 value of approximately 157.45µg/mL. While less potent than pure Ascorbic Acid (IC50 ≈14.15µg/mL), the extract shows high efficacy for a crude botanical (Anisuzzman M., *et al*., 2016) [1]

2. **Reducing Power Assay**

The "Ferric Reducing" capacity of the root is prominent. The presence of reductions in the extract converts Fe3+ to Fe2+, a reaction that increases linearly with extract concentration. This suggests the root can act as a significant secondary antioxidant by breaking radical chains.

Therapeutic Correlations

The high phenolic content is directly correlated with the plant's traditional use in treating oxidative stress-induced damage. The antioxidant capacity likely underpins its Analgesic and Neuropharmacological effects, such as reducing locomotor activity and inducing sleep in mice models (Hafiz *et al*., 2019).

Antibacterial Activity

The traditional use of *C. turgida* for treating infections and "blood purification" has been validated through *in vitro* antimicrobial screening.

1. **Spectrum of Activity**

Root extracts demonstrate a moderate to significant antibacterial effect, primarily against Gram-negative and Gram-positive pathogens.

2. **Minimum Inhibitory Concentration (MIC)**

Recent studies using the **broth microdilution method** indicate that the hydroethanolic root extract is highly effective against *E. coli* (MTCC 45) (Jena *et al*., 2016). The antimicrobial potency is attributed to:

1. **Saponins:** Which disrupt bacterial cell membranes.
2. **Tannins:** Which precipitate bacterial proteins and inhibit enzyme activity.
3. **Alkaloids:** Which interfere with DNA replication in the pathogen.

Conclusion and Future Perspectives

The current literature confirms that the root of *Ceriscoides turgida* is a potent source of natural antioxidants and antimicrobial agents. Its traditional reputation in ethnomedicine is scientifically supported by its high phenolic and triterpenoid concentrations.

Despite these promising findings, significant gaps remain:

1. ***In vivo* Toxicity:** Long-term toxicity studies in animal models are required to establish a "No Observed Adverse Effect Level" (NOAEL).

2. **Molecular Docking:** Future studies should use *in silico* docking to identify which specific triterpenes bind to bacterial enzymes or inflammatory markers like COX-2.

3. **Isolation:** Transitioning from "crude extracts" to "isolated pure compounds" is necessary to standardize dosages for potential drug development.

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