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Phytochemical characterization and antioxidant potential of nothapodytes nimmoniana: A Rare source of camptothecin

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Abstract
Nothapodytes nimmoniana, a medicinally significant and endangered plant species, is widely acknowledged as a potent natural source of the anti-cancer alkaloid camptothecin (CPT). The present study aims to perform a comprehensive phytochemical characterization of various extracts of N. nimmoniana and evaluate their antioxidant potential. Preliminary qualitative and quantitative analyses revealed the presence of key secondary metabolites including alkaloids, flavonoids, phenols, saponins, and tannins. High-performance thin-layer chromatography (HPTLC) and high-performance liquid chromatography (HPLC) techniques confirmed the presence and quantified the concentration of camptothecin in different plant parts, with the highest yield observed in the stem bark extract. The antioxidant activity was assessed using DPPH, ABTS, and FRAP assays, indicating significant free radical scavenging potential. The strong correlation between phytochemical content and antioxidant activity suggests that N. nimmoniana not only serves as a valuable reservoir of camptothecin but also possesses considerable therapeutic potential due to its antioxidant properties. These findings underscore the importance of conserving this rare species and harnessing its phytopharmaceutical value in drug development, particularly for oxidative stress-related diseases.

Keywords: Nothapodytes nimmoniana, camptothecin, antioxidant activity, phytochemical analysis, HPTLC, HPLC, free radicals, medicinal plants

Introduction

Medicinal plants have long been a cornerstone in traditional healthcare systems and modern drug development, offering an inexhaustible reservoir of bioactive compounds with diverse therapeutic applications. Among such plants, Nothapodytes nimmoniana (Grah.) Mabb., a member of the family Icacinaceae, has garnered significant attention due to its content of camptothecin—a potent quinoline alkaloid with established anticancer properties.

Camptothecin (CPT), first isolated in the 1960s, inhibits the DNA enzyme topoisomerase I, thereby halting DNA replication and inducing apoptosis in rapidly dividing cancer cells. Although initially extracted from Camptotheca acuminata, the limited availability and slow growth of this species prompted researchers to explore alternative sources. N. nimmoniana, endemic to the Western Ghats of India and now classified as endangered due to overharvesting, has emerged as a sustainable and efficient CPT source.

Besides its anticancer properties, N. nimmoniana is reputed in folk medicine for its anti-inflammatory, antidiabetic, and antimicrobial effects—attributable to its rich phytochemical profile. Secondary metabolites such as alkaloids, flavonoids, and phenolics not only contribute to its pharmacological activities but also play a critical role in combating oxidative stress—a fundamental factor in aging and various chronic diseases.

In this context, the present study is designed with the following objectives

1. To qualitatively and quantitatively assess the phytochemical constituents of different parts of N. nimmoniana.
2. To evaluate its antioxidant potential using standard in *vitro* assays.
3. To confirm the presence and determine the concentration of camptothecin through advanced chromatographic techniques.

Understanding the phytochemical makeup and antioxidant efficacy of this rare species will provide insight into its therapeutic value and support conservation and sustainable utilization strategies.

Materials and Methods

1. Plant Material Collection

Fresh plant materials (leaves, stem bark, and roots) of Nothapodytes nimmoniana were collected from the Western Ghats region of Maharashtra, India, during the post-monsoon season. The specimens were authenticated by a botanist, and voucher samples were deposited in the herbarium for reference.

2. Preparation of Extracts

The collected plant parts were shade-dried, powdered, and subjected to extraction using solvents of increasing polarity (hexane, ethyl acetate, methanol, and aqueous) via Soxhlet apparatus. The extracts were concentrated under reduced pressure and stored at 4°C until further analysis.

3. Preliminary Phytochemical Screening

Standard protocols were followed for qualitative testing of alkaloids, flavonoids, saponins, tannins, phenols, terpenoids, and glycosides.

4. Quantitative Estimation of Phytochemicals

Total phenolic content (TPC) was measured using the Folin-Ciocalteu method.

Total flavonoid content (TFC) was determined by the aluminum chloride colorimetric assay.

Alkaloid content was estimated by gravimetric analysis.

5. HPTLC and HPLC Analysis

Camptothecin was identified and quantified using HPTLC (Camag, Switzerland) and HPLC with a UV detector set a 254 nm. Standard camptothecin was used as reference.

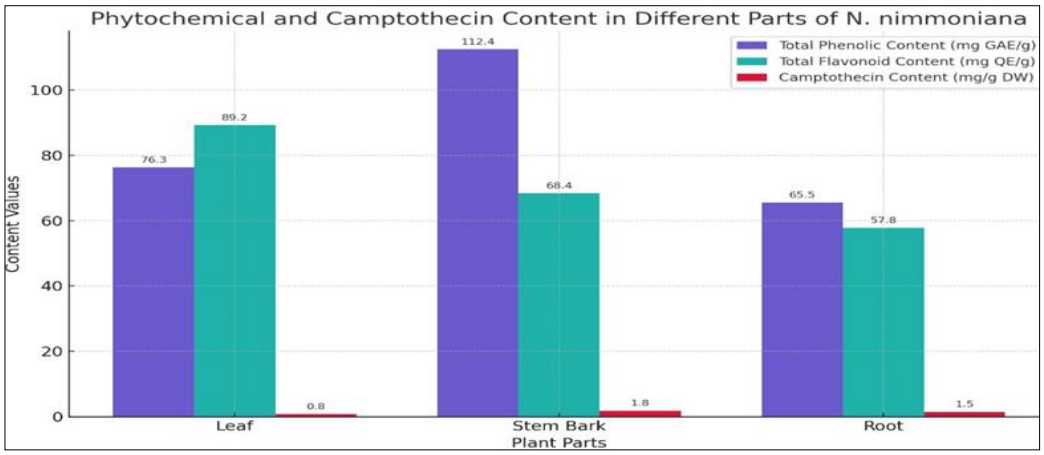
6. Antioxidant Assays

DPPH radical scavenging assay
ABTS radical cation decolorization assay
Ferric Reducing Antioxidant Power (FRAP)

All assays were performed in triplicate and expressed in terms of Trolox equivalents.

Results and Discussion

Plant Part	Total Phenolic Content (mg GAE)	Total Flavonoid Content (mg QE)	Camptothecin Content (mg/g DW)
Leaf	76.3	89.2	0.82
Stem Bark	112.4	68.4	1.82
Root	65.5	57.8	1.49



1. Phytochemical Screening

All solvent extracts showed the presence of major secondary metabolites. Methanolic extract revealed the highest diversity of compounds, particularly phenolics and flavonoids.

2. Quantitative Analysis

TPC ranged from 43.6 to 112.4 mg GAE/g extract, highest in methanol extract of the stem bark.
TFC was highest in the leaf extract (89.2 mg QE/g).
Alkaloid content was most abundant in root and stem bark extracts.

3. HPTLC and HPLC Findings

HPTLC fingerprinting confirmed the presence of camptothecin at Rf 0.41 in stem and root extracts. HPLC quantification revealed the highest CPT concentration in the stem bark (1.82 mg/g DW), consistent with earlier studies.

4. Antioxidant Activity

All tested extracts exhibited strong antioxidant activity:
DPPH IC50 values ranged from 34.2 to 67.8 µg/mL.
ABTS scavenging capacity was highest in methanolic stem bark extract.
FRAP values correlated positively with phenolic content.

Discussion

The correlation between high phenolic/flavonoid content and antioxidant potential highlights the therapeutic promise of N. nimmoniana. Its camptothecin yield further enhances its pharmacological relevance, positioning it as a dual-action plant for both antioxidant and anticancer applications. Conservation of this species is crucial for future pharmacognostic research and sustainable drug development.

Conclusion

Nothapodytes nimmoniana demonstrates a rich phytochemical composition and significant antioxidant potential, in addition to being a rare and potent source of camptothecin. These findings reaffirm its ethnopharmacological significance and reinforce the urgent need for conservation strategies and cultivation efforts to prevent its extinction. Furthermore, the study offers a foundation for developing standardized extracts and formulations for therapeutic use, especially targeting oxidative stress and cancer.

References

1. Wall ME, Wani MC, *et al*. Plant Antitumor Agents. I. The Isolation and Structure of Camptothecin. Journal of the American Chemical Society,1966:88(16):3888–3890.
2. Govindachari TR. Chemistry of Nothapodytes foetida. Fitoterapia,1990:61:265–268.
3. Suresh J, Prasad NBL, *et al*. Phytochemical and antioxidant studies of Nothapodytes nimmoniana. Indian Journal of Pharmaceutical Sciences,2011:73(2):240–243.
4. Singleton VL, Rossi JA. Colorimetry of total phenolics. American Journal of Enology and Viticulture,1965:16:144–158.
5. Brand-Williams W, Cuvelier ME, *et al*. Use of a free radical method to evaluate antioxidant activity. LWT - Food Science and Technology,1995:28(1):25–30.