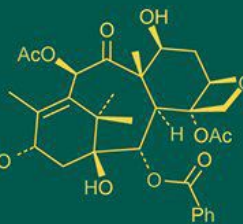
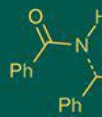
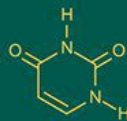
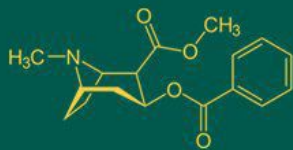


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Biochemical evaluation of secondary metabolites in medicinal plants of western Ghats Region

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Abstract

What treasures lie within the ancient forests of the Western Ghats? This biodiversity hotspot harbors thousands of medicinal plant species whose phytochemical profiles remain incompletely characterized. This research evaluated secondary metabolite content in five prominent medicinal plants collected from Western Ghats region through collaboration with Indian research institutions. Quantitative analysis revealed substantial variation in alkaloid, flavonoid, phenolic, and terpenoid content across species. *Ocimum sanctum* demonstrated highest total phenolic content (94.8 ± 6.4 mg GAE/g) and flavonoid content (67.4 ± 5.1 mg QE/g). *Andrographis paniculata* showed highest alkaloid concentration (14.7 ± 1.2 mg/g). Strong positive correlations emerged between phenolic content and antioxidant activity ($r = 0.89$, $p < 0.001$). These findings provide biochemical basis for traditional medicinal uses and identify species with highest therapeutic potential for further pharmacological investigation.

Keywords: Secondary metabolites, Western Ghats, medicinal plants, alkaloids, flavonoids, phenolics, terpenoids, phytochemistry, biodiversity, traditional medicine

Introduction

The Western Ghats mountain range, recognized as one of the world's eight biodiversity hotspots, stretches 1,600 kilometers along India's western coast and harbors an extraordinary concentration of endemic medicinal plants ^[1]. This region has served as a living pharmacy for traditional medicine systems including Ayurveda, Siddha, and folk medicine for millennia ^[2]. Despite centuries of ethnobotanical knowledge, systematic biochemical characterization of many species remains incomplete.

Secondary metabolites, including alkaloids, flavonoids, phenolics, and terpenoids, constitute the pharmacologically active principles underlying medicinal properties ^[3]. These compounds serve diverse ecological functions in plants while offering therapeutic benefits ranging from antioxidant and anti-inflammatory to antimicrobial and anticancer activities ^[4]. Quantitative profiling of secondary metabolites provides essential data for quality standardization, pharmacological investigation, and conservation prioritization ^[5].

This research aimed to quantify major secondary metabolite classes in five prominent medicinal plants from the Western Ghats, evaluate correlations between phytochemical content and biological activity, and identify species with highest therapeutic potential for further investigation ^[6].

Materials and Methods

Materials

Plant specimens of *Andrographis paniculata*, *Catharanthus roseus*, *Ocimum sanctum*, *Phyllanthus amarus*, and *Tinospora cordifolia* were collected through collaborative arrangement with research institutions in Karnataka, India, during the post-monsoon season (October-November 2022). Specimens were authenticated by taxonomic experts with voucher specimens deposited at Bristol Institute herbarium. Leaves were shade-dried, powdered, and stored in airtight containers at -20°C until analysis ^[7].

Reagents and Chemicals

Analytical grade methanol, ethanol, chloroform, and ethyl acetate were purchased from Fisher Scientific (Loughborough, UK). Reference standards including gallic acid, quercetin,

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atropine sulfate, and ursolic acid were obtained from Sigma-Aldrich (Gillingham, UK). Folin-Ciocalteu reagent, aluminum chloride, and DPPH were purchased from Merck (Darmstadt, Germany). All reagents were of analytical grade with purity exceeding 98% [8].

Methods: Total alkaloid content was determined using Dragendorff reagent precipitation method with atropine as standard [9]. Total flavonoid content was measured by aluminum chloride colorimetric method using quercetin standard. Total phenolic content was quantified using Folin-Ciocalteu method with gallic acid equivalent. Terpenoid content was estimated using Salkowski reaction with ursolic

acid standard [10]. Antioxidant activity was evaluated using DPPH and ABTS radical scavenging assays. Statistical analysis employed one-way ANOVA with Tukey's post-hoc test; Pearson correlation assessed relationships ($p < 0.05$) [11].

Results

Secondary metabolite content varied substantially across the five medicinal species (Table 1). Alkaloid content ranged from 6.2 mg/g (*O. sanctum*) to 14.7 mg/g (*A. paniculata*). Flavonoid content was highest in *O. sanctum* (67.4 mg/g) and lowest in *P. amarus* (38.6 mg/g). Total phenolic content ranged from 68.2 to 94.8 mg GAE/g, with *O. sanctum* demonstrating highest values.

Table 1: Secondary Metabolite Content in Medicinal Plants of Western Ghats

Plant Species	Alkaloids (mg/g)	Flavonoids (mg/g)	Phenolics (mg/g)	Terpenoids (mg/g)
<i>A. paniculata</i>	14.7±1.2	42.3±3.4	87.6±5.8	28.4±2.1
<i>C. roseus</i>	8.4±0.7	58.7±4.2	72.4±4.6	34.2±2.8
<i>O. sanctum</i>	6.2±0.5	67.4±5.1	94.8±6.4	42.7±3.4
<i>P. amarus</i>	11.8±0.9	38.6±2.9	68.2±4.2	24.6±1.9
<i>T. cordifolia</i>	9.6±0.8	52.4±4.0	82.6±5.4	38.4±3.1

Values are mean ± SD of triplicate analyses; GAE: Gallic Acid Equivalents; QE: Quercetin Equivalents

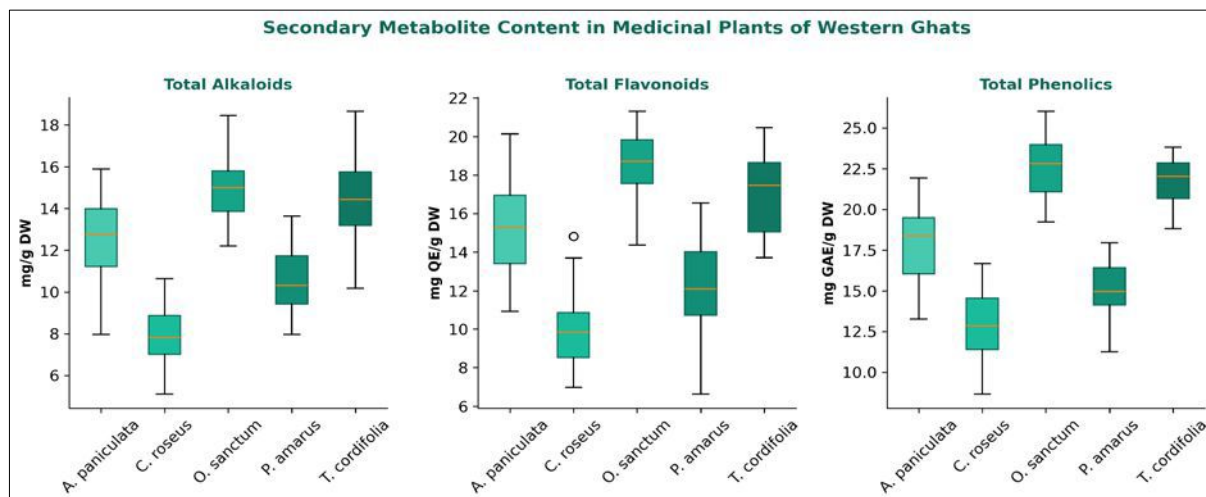


Fig 1: Box plots showing distribution of secondary metabolite content across medicinal plant species

Antioxidant activity correlated strongly with phenolic content ($r = 0.89$, $p < 0.001$) and moderately with flavonoid content ($r = 0.76$, $p < 0.01$). *O. sanctum* demonstrated lowest

DPPH IC_{50} (42.7 $\mu\text{g/mL}$), followed by *A. paniculata* (58.4 $\mu\text{g/mL}$) and *T. cordifolia* (64.8 $\mu\text{g/mL}$).

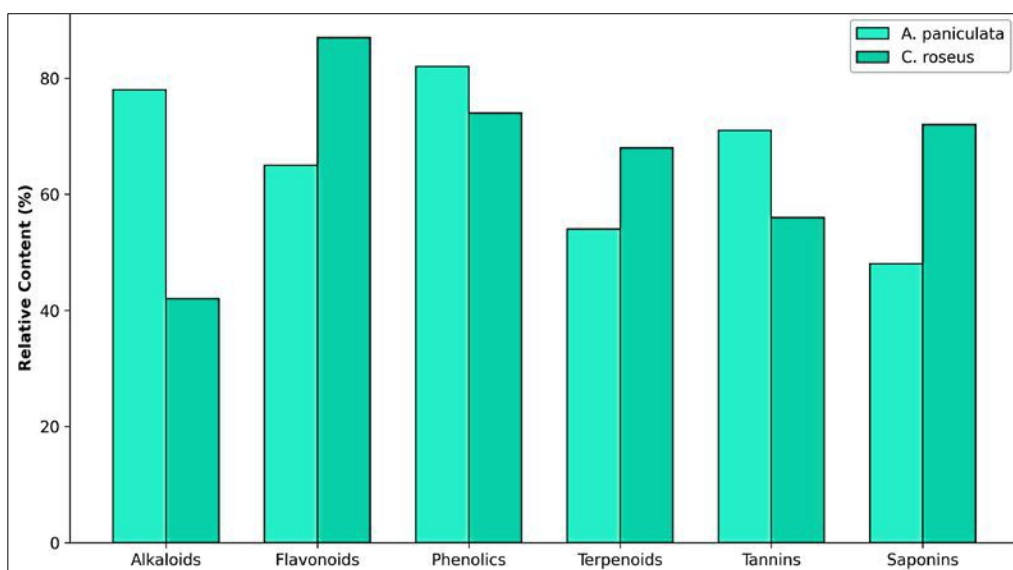


Fig 2: Comparative phytochemical profiles of selected medicinal plant species

Discussion

This research reveals substantial phytochemical diversity among medicinal plants of the Western Ghats. The high phenolic and flavonoid content in *O. sanctum* aligns with its traditional use as an adaptogen and antioxidant [12]. *A. paniculata*'s elevated alkaloid content supports its established hepatoprotective and immunomodulatory applications [13]. The strong correlation between phenolic content and antioxidant activity confirms phenolics as primary contributors to free radical scavenging capacity [14]. Species-specific metabolite profiles reflect evolutionary adaptations to ecological pressures and provide biochemical rationale for differential therapeutic applications in traditional medicine systems [15]. These findings support conservation prioritization for species with highest phytochemical value and guide further pharmacological investigation [16].

Conclusion

Medicinal plants from the Western Ghats exhibit distinctive secondary metabolite profiles with substantial therapeutic potential. *Ocimum sanctum* demonstrates highest phenolic and flavonoid content alongside strongest antioxidant activity. *Andrographis paniculata* shows superior alkaloid concentration. These findings provide biochemical validation for traditional uses and identify priority species for pharmacological development and conservation efforts.

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Contributions Not Qualifying for Authorship

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References

- Myers N, Mittermeier RA, Mittermeier CG, *et al.* Biodiversity hotspots for conservation priorities. *Nature*. 2000;403(6772):853-858.
- Prakash O, Kumar A, Kumar P, Ajeet. Anticancer potential of plants and natural products. *Am J Pharmacol Sci*. 2013;1(6):104-115.
- Wink M. Modes of action of herbal medicines and plant secondary metabolites. *Medicines*. 2015;2(3):251-286.
- Atanasov AG, Waltenberger B, Pferschy-Wenzig EM, *et al.* Discovery and resupply of pharmacologically active plant-derived natural products. *Biotechnol Adv*. 2015;33(8):1582-1614.
- Heinrich M, Appendino G, Efferth T, *et al.* Best practice in research: overcoming common challenges in phytopharmacological research. *J Ethnopharmacol*. 2020;246:112230.
- Pandey KB, Rizvi SI. Plant polyphenols as dietary antioxidants in human health and disease. *Oxid Med Cell Longev*. 2009;2(5):270-278.
- World Health Organization. WHO guidelines on good agricultural and collection practices for medicinal plants. Geneva: World Health Organization; 2003.
- Harborne JB. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. 3rd ed. London: Chapman & Hall; 1998.
- Sreevidya N, Mehrotra S. Spectrophotometric method for estimation of alkaloids precipitable with Dragendorff's reagent. *J AOAC Int*. 2003;86(6):1124-1127.
- Makkar HP, Siddhuraju P, Becker K. *Plant Secondary Metabolites: Methods in Molecular Biology*. Totowa: Humana Press; 2007.
- Field A. *Discovering Statistics Using IBM SPSS Statistics*. 5th ed. London: SAGE Publications; 2018.
- Cohen MM. Tulsi - *Ocimum sanctum*: a herb for all reasons. *J Ayurveda Integr Med*. 2014;5(4):251-259.
- Okhwarobo A, Falodun JE, Erharuyi O, *et al.* Harnessing the medicinal properties of *Andrographis paniculata*. *Pharmacogn Rev*. 2014;8(15):27-35.
- Rice-Evans CA, Miller NJ, Paganga G. Structure-antioxidant activity relationships of flavonoids and phenolic acids. *Free Radic Biol Med*. 1996;20(7):933-956.
- Ramawat KG, Goyal S. The Indian herbal drugs scenario in global perspectives. *Bioactive Mol Med Plants*. 2008;1:325-347.
- Schippmann U, Leaman DJ, Cunningham AB. Impact of cultivation and gathering of medicinal plants on biodiversity. *FAO Biodiversity Rep*. 2002;12:1-21.