

THE MEDICINAL POTENTIAL OF ORCHIDS FROM BILASPUR DIVISION, CHHATTISGARH: A REVIEW

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Abstract

Chhattisgarh in India is known as the Herbal State of India, boasts a rich diversity of medicinal plants, including orchids. The Bilaspur Division, with its lush, forested areas, harbours numerous native orchid species, many of which are utilized in traditional medicine. Despite their therapeutic potential, scientific evaluation of their phytochemical properties remains limited. The present review consolidates current knowledge on the phytochemical composition and medicinal potential of orchids in the region, highlighting the key research findings, and identifying critical research gaps. The present communication attempts to highlight conservation needs and also the prospects for pharmaceutical and nutraceutical applications.

Introduction

ORCHIDS, BELONGING to the family Orchidaceae, represent one of the largest and most evolutionarily advanced plant families, comprising 29,481 species distributed in 693 genera distributed in the world (POWO, 2025; WFO, 2023). Renowned for their intricate floral morphology and ecological diversity, orchids are not only valued for their ornamental appeal but also for their significant ethnomedicinal and pharmacological properties. In traditional healing systems like Ayurveda, Siddha, and indigenous tribal practices, different species of orchids have been utilized to treat a wide range of conditions, including fever, wounds, respiratory issues, and sexual dysfunction.

India, with its vast geographical and climatic diversity, hosts 1,256 species belonging to 155 genera (Singh *et al.*, 2019); many of which are endemic to specific regions. Amongst them, the state of Chhattisgarh, often referred to as the Herbal State of India, is endowed with rich forest biodiversity and a wealth of indigenous medicinal knowledge. The Bilaspur division, encompassing forested regions and tribal habitats, is a hotspot for various orchid species that hold cultural and medicinal significance for local communities.

Despite their therapeutic potential and extensive use in folk medicine, orchids in the Bilaspur division have received minimal scientific attention concerning their phytochemical composition. While global research has identified the presence of bioactive compounds such as alkaloids, flavonoids, phenolic, glycosides, and terpenoids in several orchid species (Hoque *et al.*, 2021; Kumari and Pathak, 2025a,b), analogous studies from Chhattisgarh are a few and fragmented. This lack of comprehensive phytochemical profiling and

pharmacological validation poses a challenge to both scientific advancement and sustainable conservation efforts. This communication seeks to address the gap by systematically compiling existing research on the phytochemical properties of orchids in the Bilaspur region, with an emphasis on its findings and implications. In this context, the present study was conducted to: i) analyze the reported phytoconstituents and their associated bioactivities; ii) document traditional uses among local tribes; iii) highlight key findings from both national and international studies for comparative analysis; and iv) identify important research and conservation gaps.

Orchids in Medicine

Orchids represent one of the most diverse plant families globally and these are renowned not only for their ecological significance and aesthetic value but also for their rich repository of bioactive secondary metabolites. Across the world, especially in regions like China and Southeast Asia, extensive research has unveiled a wide array of phytochemicals in orchids- such as alkaloids, flavonoids, anthocyanins, and bibenzyl derivatives- highlighting their potent antimicrobial, antioxidant, and anti-inflammatory properties. In particular, species like *Dendrobium* have gained prominence for their therapeutic roles in Traditional Chinese Medicine. Though orchid phytochemistry within India is an emerging field, the research on identifying pharmacologically active compounds is limited. Chhattisgarh, despite being rich orchid biodiversity and deep-rooted traditional medicinal knowledge, is underexplored region in terms of phytochemical analysis and pharmacological validation in orchids. This necessitates the need for a more systematic and

region-specific approach to orchid research in Chhattisgarh, integrating modern scientific techniques with ethnobotanical insights to fully harness their medicinal potential.

Global and National Overview of Orchid Phytochemistry

Orchids have been widely studied globally for their rich secondary metabolite content. Several international studies (Gutiérrez, 2010; Hossain, 2011; Hoque *et al.*, 2024; Paul *et al.*, 2022; Rahman *et al.*, 2023;) have demonstrated that orchids produce a variety of phytochemicals including alkaloids, flavonoids, anthocyanins, and bibenzyl derivatives. These compounds possess notable bioactivities such as antimicrobial, antioxidant, cytotoxic, and anti-inflammatory effects. In particular, *Dendrobium* species have been extensively investigated in China and SouthEast Asia for their application in Traditional Chinese Medicine (TCM), where they are valued for their tonic and anti-ageing properties. Studies on medicinal orchids have been made by a few authors (Pathak *et al.*, 2010; Kumari and Pathak, 2020, 2025a,b; Sharma and Pathak, 2024; Singh and Duggal, 2020; and Srivastava *et al.*, 2021).

Phytochemicals and their Pharmacological Relevance

Orchids are a rich source of various bioactive compounds with significant therapeutic properties. Amongst the most prominent classes are alkaloids, which exhibit analgesic and neuroprotective effects, and the flavonoids and polyphenols, which are known for their potent antioxidant activity, contributing to cancer prevention and cardiovascular health. Glycosides and saponins have demonstrated immunomodulatory and anti-inflammatory effects, while phenolic acids and tannins possess antimicrobial and wound-healing capabilities. *Coelogyne cristata* has been found to contain phenanthrenes with cytotoxic properties (Kumar *et al.*, 2019), and *Rhynchostylis retusa* exhibits notable anti-inflammatory and analgesic effects (Deshmukh *et al.*, 2019). These findings underscore the pharmacological potential of orchids, supporting their traditional use in medicine and highlighting the need for further research for their bioactive constituents.

Orchids in Traditional and Folk Medicine

Many orchids are used in Ayurveda, Siddha, and tribal medicine (Pathak *et al.*, 2001). Ethnobotanical surveys conducted by Shukla (2022) in Chhattisgarh revealed that tribes use orchid tubers and extracts for treating

ailments like diarrhoea, wounds, and respiratory infections. However, the transmission of this traditional knowledge is often oral, undocumented, and is at risk of being lost. Despite their widespread use, the lack of phytochemical validation for many of these orchid species limits their acceptance in mainstream medicine. Local tribal communities such as the Baiga, Gond, and Oraon use orchid species in treating ailments like fever, cuts, respiratory infections, and reproductive health issues. *Vanda tessellata*, known locally as *Rasna*, is traditionally used for treating joint pain and inflammation. However, these uses remain largely anecdotal in the absence of formal pharmacological validation and toxicity profiling.

Medicinal Orchids in Chhattisgarh and Bilaspur Division

Research on orchids in Chhattisgarh, particularly in the biodiverse Bilaspur division, dominated by Sal and Teak forests, remains limited despite the region harbours significant species including *Aerides crispa* Lindl., *Habenaria plantaginea* Lindl., and *Vanda tessellata* (Roxb.) Hook. ex G.Don. While these orchids hold ecological and potential medicinal value, phytochemical studies are sparse. Soni *et al.* (2018) though conducted preliminary screening of five different species of orchids revealing chlorophylls and carotenes, comprehensive profiling is lacking. Mishra and Das (2021) documented the traditional uses of orchids by tribal communities, but did not include chemical validation, whereas Raj *et al.* (2020) provided a general overview of medicinal applications without species-specific phytochemical data. These gaps highlight the necessity for systematic research to uncover the bioactive potential of orchids in Chhattisgarh, integrating ethnobotanical knowledge with contemporary pharmacological analysis.

Habenaria plantaginea, a rare terrestrial orchid native to Chhattisgarh's Keshkal forest, is facing severe population decline due to habitat destruction and climate change (Soni and Shahi, 2022). This species, previously documented in Raipur and Surguja, presently showed limited distribution, with only 3-7 individuals per kilometre in the Bilaspur division, highlighting thereby its threatened status. Studies emphasize its ecological sensitivity and the urgent need for its conservation, as anthropogenic pressures and shifting environmental conditions would further endanger its survival.

Epiphytic orchids, known for their ecological and medicinal importance, have gained attention in research exploring their chlorophyll and carotenoid levels, as well as their antioxidant properties. A study by Soni *et al.* (2018) highlighted diethyl ether (DEE) as the most

effective solvent for pigment extraction, especially in species such as *Aerides multiflora* Roxb. and *Bulbophyllum* sp. This finding aligns with earlier studies in ferns (Sumanta *et al.*, 2014), reinforcing the solvent's efficacy in obtaining plant pigments. The study revealed distinct chlorophyll levels linked to photosynthetic adaptations, with CAM-adapted *Bulbophyllum* exhibiting lower chlorophyll content as compared to the species like *Dendrobium*. The spectrophotometric analyses as outlined by Lichtenthaler and Wellburn (1983) and Porra *et al.* (1989) provided precise quantification of these pigments. Antioxidant assays revealed *Bulbophyllum*'s impressive DPPH inhibition (96.37%), highlighting its potential medicinal value, as reported by Chinsamy *et al.* (2014). However, significant gaps persist in understanding the underlying biochemical mechanisms responsible for these properties and how environmental factors may influence them. To address this, future research should broaden its scope to include a wider range of species, adopt metabolomics techniques, and investigate the practical pharmacological applications of these plants. This approach will help in bridging the gap between traditional medicinal use and phytochemical evidence, offering new insights into the biomedical potential of *Bulbophyllum* and related species.

Literature studies revealed that orchids contain a diverse range of secondary metabolites. Commonly identified phytoconstituents include alkaloids in *Dendrobium nobile* with analgesic, antipyretic, and neuroprotective properties; flavonoids and phenolic compounds in *Vanda tessellata* and *Habenaria intermedia*, known for their antioxidant, anti-inflammatory, and antimicrobial effects; terpenoids from *Dendrobium* and *Bulbophyllum* species, offering anticancer and antifungal activity; and glycosides and saponins in *Cymbidium aloifolium*, which exhibit cardioactive and immunomodulatory effects. While these compounds are well-documented globally, the specific phytochemical profiling of orchids in Bilaspur remains limited, with studies largely qualitative rather than quantitative.

Comparative Insights and Thematic Gaps

Comparative analysis of orchid research across Indian states revealed significant regional disparities and thematic gaps. The NorthEastern states such as Assam, Meghalaya, and Arunachal Pradesh have made notable progress, with well-documented floristic surveys and phytochemical studies that highlight the rich orchid diversity in the region. In contrast, Southern India has focused on industrial applications, particularly in the cultivation and utilization of *Vanilla* orchids for flavouring purposes. However, states like Chhattisgarh, despite

possessing a rich repository of orchid species and a strong foundation of traditional ethnobotanical knowledge, remain underrepresented in scientific literature and research initiatives. Thematic gaps in orchid research across the country include a lack of comprehensive quantitative phytochemical profiling, minimal use of *in vitro* and *in vivo* bioassays for validating biological activity, and the absence of standardized protocols for compound extraction. Furthermore, there is limited research addressing species-specific or seasonal variations in phytochemical composition, which are crucial for accurate medicinal and industrial applications. Addressing these gaps could pave the way for sustainable utilization and conservation of orchid biodiversity in India.

Critical Research Gaps

The research gaps include i), Geographical Limitation: Most phytochemical research focuses on regions outside Bilaspur, leaving local orchids underexplored; ii) Lack of Standardization: Variability in extraction methods and analytical tools (e.g., HPLC, GC-MS) across studies limits reproducibility and comparability; iii) Insufficient Bioactivity Testing: Few studies have performed comprehensive bioactivity assays to substantiate the therapeutic claims of orchids; iv) Conservation Concerns: Habitat degradation, coupled with overharvesting for medicinal and ornamental purposes, threatens orchid populations, yet conservation-focused research remains minimal; v) Industrial Potential: There is limited research into the pharmaceutical or nutraceutical potential of orchid phytochemicals; and vi) Documentation Gaps: Ethnobotanical knowledge is often lost due to oral transmission and a lack of collaboration between researchers and local healers, leaving valuable information undocumented.

Conservation and Sustainable Use

Orchids face ecological threats due to habitat loss, overharvesting, and climate change. Conservation strategies should involve: i), *in situ* and *ex situ* propagation; ii) ethnobotanical documentation; iii) habitat preservation; and iv), community engagement in sustainable harvesting practices. In this connection it is worthwhile to mention that some successful attempts have been made to conserve some of the RET species of diverse habits and habitats by *in vitro* propagation (Bhowmik and Rahman, 2023; Dhillon and Pathak, 2023; Kirti *et al.*, 2023; Kumari and Pathak, 2021; Pathak *et al.*, 2022, 2023; Sembi *et al.*, 2011; Sunita *et al.*, 2021; Tripura *et al.*, 2022). On the similar

lines, there is an urgent need to conduct studies in medicinally important RET (rare, endangered, and threatened) and endemic orchid species of Chattisgarh.

Future researches on orchids should also prioritize comprehensive quantitative phytochemical analysis using advanced analytical techniques such as HPLC, LC-MS, and NMR to accurately identify and profile bioactive compounds. Bioactivity-guided fractionation should be undertaken to isolate and characterize lead compounds with therapeutic potential, bridging the gap between traditional use and modern pharmacology. Collaborations with local communities through ethnopharmacological approaches are essential to preserve indigenous knowledge and ensure ethical bioprospecting.

Conclusion

The present communication highlights the urgent need for in-depth phytochemical and pharmacological research on orchids native to the Bilaspur Division of Chhattisgarh. While traditional uses are well-documented, there is a lack of scientific exploration into their bioactive compounds. Future studies should prioritize standardized extraction methods, comprehensive bioactivity testing, and sustainable conservation approaches. Such research will not only validate traditional healing practices but also pave the way for drug discovery and biodiversity conservation.

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