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Phytochemical Profiling and Antifungal Potential of Wild *Ocimum* Species: A Comparative Evaluation of Bioactive Extracts

Vaishanavi Pawar[1] & Jyoti Kshirsagar[2]
[1]Research Scholar, Department of Botany, Jes College, Jalna – 431203 (Ms), India
[2]Associate Professor, Department of Botany,
Mrs. Kesharbai Sonajirao Kshirsagar A. C. S. College, Beed
Corresponding Author – Vaishanavi Pawar
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Abstract:

The genus Ocimum represents a significant source of bioactive phytochemicals that have extensive ethnomedicinal and pharmacological applications. This study explored the phytochemical diversity and antifungal potential of various wild Ocimum species (O. americanum, O. tenuiflorum, O. basilicum, and O. gratissimum) collected from the Marathwada region of Maharashtra, India. Using Soxhlet extraction with solvents of varying polarity, we observed interspecific variations in the phytochemical profiles. Notably, O. basilicum and O. americanum exhibited the greatest diversity, containing alkaloids, flavonoids, phenolics, and terpenoids, while O. gratissimum showed a more limited range with only phenolics, terpenoids, and glycosides present. Antifungal assays conducted against phytopathogens such as Aspergillus niger, Fusarium oxysporum, Alternaria alternata, and Rhizoctonia solani demonstrated significant inhibition zones in O. basilicum (20.3 ± 0.2 mm against A. niger; 21.0 ± 0.3 mm against A. alternata) and O. americanum (18.5 ± 0.3 mm against A. niger; 17.8 ± 0.4 mm against A. alternata). In contrast, O. gratissimum exhibited lowest antifungal activity, with inhibition zones ranging from 6.8 to 9.2 mm across different strains. These results affirm a direct correlation between phytochemical richness and antifungal effectiveness, highlighting O. basilicum as a particularly promising natural source of antifungal agents. This study underscores the potential of wild Ocimum species for the development of sustainable, plant-based antifungal solutions.

Keywords: Ocimum Species; Phytochemical Profiling; Antifungal Activity; Bioactive Metabolites; Inhibition Zone; Natural Antifungal Agents

Introduction:

The genus *Ocimum* encompasses a diverse group of plants widely recognized for their significant ethnomedicinal applications and pharmacological potential across various cultures (Chinedu & C, 2021). These species are extensively researched for their utility in conventional therapeutic practices, exhibiting a broad spectrum of activities including antimalarial, anticancer, antidiabetic, anti-inflammatory, and antioxidant effects (Chinedu & C, 2021). This broad therapeutic range is largely attributed to the rich phytochemical profiles of Ocimum species, which include flavonoids, alkaloids, saponins, tannins, and phenols, all contributing to their bioactive properties (Halim *et al.*, 2022; Mazumder *et al.*, 2023). Specifically, recent investigations have focused on the antimicrobial efficacy of Ocimum extracts, with studies demonstrating their capacity to inhibit the growth of various pathogenic microorganisms, including fungi (Chanthaboury *et al.*, 2022). This highlights

their potential as natural antifungal agents, offering an alternative to synthetic fungicides, which often face issues of resistance and environmental persistence (Sharifi-Rad *et al*., 2021). Consequently, a deeper understanding of the chemical constituents responsible for the antifungal activity in wild Ocimum species is crucial for developing novel, sustainable antimicrobial solutions (Chinedu & C, 2021). This study aims to comparatively evaluate the phytochemical profiles and antifungal potential of bioactive extracts derived from different wild Ocimum species, thereby elucidating the specific compounds and mechanisms responsible for their observed bioactivity.

Materials and Methods:

Plant Material Collection: Wild *Ocimum* species were collected from natural habitats in the Marathwada region of Maharashtra, India. Plant specimens were authenticated by a taxonomist, and voucher specimens were deposited in the departmental herbarium.

Preparation of Extracts: Leaves of the collected species were shade-dried, powdered, and subjected to Soxhlet extraction using solvents of increasing polarity (aqueous, ethanol, and methanol). Extracts were concentrated under reduced pressure and stored at 4°C until further use. The selection of appropriate extraction techniques, such as Soxhlet extraction, significantly influences the phytochemical yield and, consequently, the biological activity of the extracts, as different methods can selectively isolate distinct classes of compounds (Yan *et al*., 2022).

Phytochemical Screening: Preliminary phytochemical tests were performed to detect the presence of secondary metabolites, including alkaloids (Mayer's test), flavonoids (Shinoda test), tannins (Ferric chloride test), phenolics (Folin–Ciocalteu reagent), terpenoids (Salkowski's test), and glycosides (Keller–Killiani test). Both qualitative and semi-quantitative assessments were recorded. These analyses are critical for establishing a foundational understanding of the complex chemical makeup of the extracts, which is directly relevant to their therapeutic applications (Mazumder *et al*., 2023).

Antifungal Assays. The antifungal activity of the extracts was tested against phytopathogenic fungi (*Aspergillus niger*, *Fusarium oxysporum*, *Alternaria alternata*, and *Rhizoctonia solani*). 100 µL of each extract was loaded into wells on PDA plates inoculated with fungal cultures. Zones of inhibition (mm) were measured after incubation at 28 ± 2°C for 72 hours. The serial dilution method was employed to determine the lowest concentration of extracts inhibiting visible fungal growth. All experiments were conducted in triplicate.

Results and Discussion:

The *Ocimum* species showed the richest phytochemical diversity, with a strong presence of alkaloids, flavonoids, phenolics, and terpenoids consistent. These results highlight the varied presence of key phytochemicals across different *Ocimum* species (Table 1).

Table 1: Phytochemical Composition and Antifungal Activity of *Ocimum* Species

Ocimum Species	Alkaloids	Flavonoids	Tannins	Phenolics	Terpenoids	Glycosides
O. americanum	+	+	–	+	+	–
O. tenuiflorum	–	+	+	+	–	+
O. basilicum (wild)	+	+	–	+	+	–
O. gratissimum	–	–	–	+	+	+

O. basilicum (wild) and *O. americanum* showed the richest phytochemical diversity, with strong presence of alkaloids, flavonoids, phenolics, and terpenoids consistent with their high antifungal activity. *O. tenuiflorum* contained flavonoids, tannins, phenolics, and glycosides but lacked alkaloids and terpenoids, aligning with its moderate antifungal activity. *O. gratissimum* had fewer bioactive groups (phenolics, terpenoids, glycosides) and lacked flavonoids/alkaloids, which explains its weaker antifungal response. These results highlight the varied presence of key phytochemicals across different Ocimum species, underscoring the influence of species-specific biosynthesis and potentially environmental factors on their chemical profiles (Mithraja *et al*., 2012).

The antifungal activity of different extracts of *Ocimum* species is summarized in Table 2, which shows variation in inhibition across fungal strains.

Table 2. Antifungal Activity of Wild *Ocimum* Species

Fungal Strain	***O. americanum***	***O. tenuiflorum***	***O. basilicum***	***O. gratissimum***
Aspergillus niger	18.5 ± 0.3	12.1 ± 0.4	20.3 ± 0.2	8.7 ± 0.5
Fusarium oxysporum	16.2 ± 0.6	10.5 ± 0.3	19.8 ± 0.4	7.1 ± 0.2
Alternaria alternata	17.8 ± 0.4	11.8 ± 0.5	21.0 ± 0.3	9.2 ± 0.6
Rhizoctonia solani	15.9 ± 0.7	10.1 ± 0.6	18.5 ± 0.5	6.8 ± 0.4

Overall, *O. basilicum* demonstrated superior antifungal activity across all tested fungal strains, corroborating its rich phytochemical profile and previously reported antimicrobial properties (Kačániová *et al*., 2022). This suggests a direct correlation between the comprehensive presence of secondary metabolites, particularly alkaloids and terpenoids, and enhanced antifungal efficacy. Conversely, species like *O. gratissimum* exhibited limited antifungal action, which can be correlated with a less diverse phytochemical composition, notably lacking key active compounds present in the more effective species.

The findings presented in this study reveal significant variations in both the phytochemical composition and antifungal efficacy among wild *Ocimum* species, underscoring the importance of species-specific evaluation for identifying promising sources of bioactive compounds. Specifically, the comprehensive phytochemical analysis demonstrated a direct correlation between the diversity and abundance of secondary metabolites like alkaloids, flavonoids, phenolics, and terpenoids, and the observed antifungal potency, with *O. basilicum* exhibiting the highest activity due to its rich constituent profile (Adámek *et al*., 2021). This aligns with previous research highlighting the significant pharmacological potential of Ocimum species, particularly *O. basilicum*, which is renowned for its diverse array of phytonutrients and antioxidant capabilities (Filip, 2017). Furthermore, the genus *Ocimum* is widely recognized for its therapeutic potential, with species like Ocimum sanctum demonstrating broad health-promoting effects through the modulation of various biological activities, including significant antioxidant, anti-inflammatory, and antimicrobial properties, alongside notable anticancer effects (Almatroodi *et al*., 2020).

Conclusion:

These properties are often attributed to the complex interplay of their bioactive compounds, which collectively contribute to their reported medicinal benefits. The rich presence of polyphenols, phenolic acids, flavonoids, and terpenoids in basil leaves, for instance, underpins its effectiveness as a potent antimicrobial and anti-inflammatory agent. This collective action of secondary metabolites ensures their efficacy against a wide range of pathogens and chronic diseases. Therefore, further research is warranted to elucidate the precise mechanisms through which these phytochemicals exert their antifungal effects and to explore their potential in novel therapeutic applications.

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References:

1. Adámek, M., Mlček, J., Adámková, A., Mišurec, V. G., Orsavová, J., Bučková, M., Búran, M., Plášková, A., & Kouřimská, L. (2021). Basil a comparison of the total phenolic content and antioxidant activity in selected cultivars. *Potravinarstvo Slovak Journal of Food Sciences*, *15*, 445.
2. Almatroodi, S. A., Alsahli, M. A., Almatroudi, A., & Rahmani, A. H. (2020). *Ocimum sanctum*: Role in Disease Management Through Modulating Various Biological Activities. *Pharmacognosy Journal*, *12*(5), 1198.
3. Azizah, N. S., Irawan, B., Kusmoro, J., Safriansyah, W., Farabi, K., Oktavia, D., Doni, F., & Miranti, M. (2023). Sweet Basil (*Ocimum basilicum* L.) A Review of Its Botany, Phytochemistry, Pharmacological Activities, and Biotechnological Development. *Plants*, *12*(24), 4148.
4. Chanthaboury, M., Choonharuangdej, S., Shrestha, B., & Srithavaj, T. (2022). Antimicrobial properties of Ocimum species: An in vitro study. *Journal of International Society of Preventive and Community Dentistry*, *12*(6), 596.
5. Chinedu, E., & C, O. C. (2021). *Ocimum* Species: Ethnomedicinal Uses, Phytochemistry and Pharmacological Importance. *International Journal of Current Research in Physiology and Pharmacology (IJCRPP)*, 1.
6. Filip, S. (2017). Basil (Ocimum basilicum L.) A Source of Valuable Phytonutrients. *International Journal of Clinical Nutrition & Dietetics*, *3*(1).
7. Halim, A. M., Cahyanurani, A. B., & Aonullah, A. A. (2022). The effect of *Ocimum sanctum* L. crude extract on haematology of *Cyprinus carpio* infected by *Aeromonas hydrophila*. *IOP Conference Series Earth and Environmental Science*, *1036*(1), 12086.
8. Kačániová, M., Galovičová, L., Borotová, P., Vuković, N. L., Vukić, M., Kunová, S., Hanus, P., Bakay, L., Zagrobelna, E., Kluz, M., & Kowalczewski, P. Ł. (2022). Assessment of Ocimum basilicum Essential Oil Anti-Insect Activity and

Antimicrobial Protection in Fruit and Vegetable Quality. *Plants*, *11*(8), 1030.

9. Mazumder, D., Sarkar, J., Gayari, R., Ahmed, I. S., Ali, M., & Nath, S. K. (2023). Physico-chemical Characterization and Qualitative Analysis of Phytochemicals Present in Food Additives Derived from *Sesamum indicum*, *Brassica nigra* Plant Wastes, and Cocos nucifera Husk. *International Journal of Ecology and Environmental Sciences*, *50*(1), 131.
10. Mithraja, M. J., Antonisamy, J. M., Mahesh, M. K., Paul, Z. M., & Jeeva, S. (2012). Chemical diversity analysis on some selected medicinally important pteridophytes of Western Ghats, India. *Asian Pacific Journal of Tropical Biomedicine*, *2*(1):19-21
11. Nguyen, V.-H., Quy, N. N., Thi, N. Q. N., Thi, C. Q. N., Trúc, T. T., & Nghi, P. T. B. (2021). Studies on chemical, polyphenol content, flavonoid content, and antioxidant activity of sweet basil leaves (*Ocimum basilicum* L.). *IOP Conference Series Materials Science and Engineering*, *1092*(1), 12083.
12. Romano, R., Luca, L. D., Aiello, A., Pagano, R., Pierro, P. D., Pizzolongo, F., & Masi, P. (2022). Basil (*Ocimum basilicum* L.) Leaves as a Source of Bioactive Compounds. *Foods*, *11*(20), 3212.
13. Sharifi-Rad, J., Adetunji, C. O., Olaniyan, O. T., Ojo, S. K. S., Samuel, M. O., Temitayo, B. T., Roli, O. I., Nimota, O. O., Oluwabunmi, B. T., Adetunji, J. B., Sharopov, F., Martins, N., & Contreras, M. del M. (2021). Antimicrobial, Antioxidant and Other Pharmacological Activities of Ocimum Species: Potential to Be Used as Food Preservatives and Functional Ingredients. *Food Reviews International*, *39*(3), 1547.
14. Teliban, G.-C., Burducea, M., Zheljazkov, V. D., Dincheva, I., Badjakov, I., Munteanu, N., Mihalache, G., Cojocaru, A., Popa, L.-D., & Stoleru, V. (2021). The Effect of Myco-Biocontrol-Based Formulates on Yield, Physiology, and Secondary Products of Organically Grown Basil. *Agriculture*, *11*(2), 180.
15. Yan, K., Cheng, X., Bian, G., Gao, Y., & Li, D. (2022). The Influence of Different Extraction Techniques on the Chemical Profile and Biological Properties of *Oroxylum indicum*: Multifunctional Aspects for Potential Pharmaceutical Applications. *Evidence-Based Complementary and Alternative Medicine*, *2022*, 1