

## **PHYTOCHEMICAL INVESTIGATION OF *OCIMUM* SPECIES: A Review**

Suchismita Barik

M.Sc. IV Semester, Kalinga University, Naya Raipur, C.G.

Email: [suchismitabarik508@gmail.com](mailto:suchismitabarik508@gmail.com)

### **INTRODUCTION**

The Lamiaceae family, commonly referred to as the mint family, encompasses around 230 genera and 7,100 species globally. This family is notably significant for its extensive uses in medicine, cooking, and cosmetics (Naghii, et al., 2022). The primary bioactive compounds present in commonly encountered Lamiaceae species consist of volatile terpenoids, essential oils, hydroxycinnamic acids, phenolic acids, and flavonoids, all of which exhibit a wide range of biological activities (Štefan et al. 2014). Phenolic compounds are a class of phytochemicals that serve as secondary metabolites in various plants. Among these, hydroxycinnamic acids (HAs) such as rosmarinic (RS), ferulic (FE), caffeic (CA), and coumaric (CU) acids are notable for their natural antioxidant properties. These phenolic compounds have attracted significant attention due to their wide range of potential health benefits, including antioxidant, anti-inflammatory, regenerative, antitarrhal, neuroprotective, antibacterial, antiviral, antidepressant, anticancer, antidiabetic, antiangiogenic, and antihepatotoxic activities (Kumar and Pruthi, 2014; Kwon et al., 2014; Moore et al., 2016).

The Lamiaceae family is rich in chemotaxonomic markers at various taxonomic levels, including family, subfamily, genus, and species, particularly in terms of polar fraction metabolites. However, for essential oils, most previously identified compounds, with perhaps one exception, do not serve as reliable chemotaxonomic markers. This is primarily due to two significant reasons: firstly, from a phytochemical perspective, these compounds have been reported in other plant families, limiting their specificity (Frezza et al., 2019). The Lamiaceae family is highly intriguing and exceptionally complex in all its facets. Its species are rich in phytochemicals and are renowned globally for their diverse applications in ethnopharmacology and nutraceuticals. However, much remains to be discovered or thoroughly studied about this family.

Asghari et al. (2017) studied that pharmacological screening of plant extracts has revealed insights into their therapeutic and toxic properties. The presence of phytochemicals with diverse pharmacological and biological activities underpins the medicinal value of various plant species, making them valuable sources of drugs in ethnomedicine. These phytochemicals serve as the active components that render plants effective in traditional medicine.

Nieto (2017) emphasizes the traditional use of spices and herbs to improve the nutritional value, sensory appeal, and preservation of food. Approved as safe (GRAS), they are great replacements for chemical additions. Natural food preservatives are being investigated for use with essential oils, which are mostly extracted by steam distillation from aromatic and medicinal plants. Notable for yielding essential oils with antibacterial and antioxidant qualities is the Lamiaceae family, which includes plants like sage, thyme, and rosemary. These oils, which are mostly found in the Mediterranean, have important implications for both ecological and economic growth. By outlining their existing usage, biological activities, and the difficulties in using them as natural food preservatives, the paper highlights the potential of essential oils to improve food shelf life.

The rising usage of medicinal plants as a substitute for synthetic medications because of their many adverse effects is covered by Uritu et al. (2018). Around 80 percent of people worldwide practice traditional medicine, which uses herbs to alleviate pain, which is a major public health concern that lowers quality of life and costs money. The study examines the analgesic qualities, active ingredients, and methods of action of the Lamiaceae family, which is well-known for its many biological and medicinal benefits. The results provide important new information for the separation of active ingredients and the creation of pharmaceutical products from Lamiaceae plants in the future.

### **Medicinal properties:**

Basil is considered a sacred herb in Indian mythology, probably because of its medicinal properties. Ayurveda recommends using it to treat severe disorders including tumorous growths in addition to respiratory, digestive, and skin ailments. Basil's potential as an immunomodulator, cytoprotective, and anticancer agent is demonstrated by experimental investigations.

The Tulsi plant, also known as Holy Basil or *Ocimum sanctum*, offers numerous benefits and uses:

**Promotes Healthy Heart:** Rich in vitamin C and antioxidants like eugenol, holy basil helps lower blood cholesterol and shields the heart from harm caused by free radicals.

**Anti-aging:** Holy basil contains phytonutrients, vitamin C and A, which are excellent antioxidants that shield the skin from practically all oxidative damage brought on by free radicals.

**Treats Kidney Stones:** Because of its moderate diuretic and detoxifying properties, tulsi aids in reducing the body's uric acid levels. Holy basil's acetic acid aids in the disintegration of the stones.

**Relieves Headaches:** One natural remedy for headaches that also helps with migraine discomfort is tulsi.

**Fights Acne:** Holy basil aids in the bacterial and infectious deaths. Eugenol, the main active ingredient in holy basil oil, is helpful in treating skin-related illnesses. *Ocimum sanctum* aids in the interior and exterior treatment of skin infections.

**Relives Fever:** Fever is traditionally treated with the herb tulsi. It is a key component in many ayurvedic medications and over-the-counter treatments.

**Eye Disorder:** Because tulsi has anti-inflammatory qualities, it helps prevent bacterial, fungal, and viral infections that can harm the eyes. It also lessens stress and relieves inflammation in the eyes.

**Oral Disease:** Tulsi is an oral disinfectant and natural mouth freshener. Mouth ulcers can also be healed by *Ocimum sanctum*. In addition to shielding the teeth, holy basil eliminates the microorganisms that cause dental cavities, plaque, tartar, and foul breath.

**Cures Respiratory Disorder:** Tulsi treats bacterial, fungal, and viral respiratory infections because it contains chemicals like cineole, eugenol, and camphene. Many respiratory conditions, including bronchitis and TB, can be cured by it.

**Rich Source of Vitamin K:** Vitamin K is a fat-soluble vitamin that is necessary for healthy bones and heart function.

## **CHARACTERISTICS:**

The spicy, bitter-tasting herb tulsi is well known for increasing lifespan, overall health, and well-being when taken regularly. It improves complexion, voice, intellect, stamina, emotional tranquility, and helps prevent a number of ailments. It also helps manage stress better. Tulsi is a fragrant herb that is used to cure a variety of conditions, including anxiety, ringworm, skin illnesses, insect bites, snake and scorpion bites, indigestion, hiccups, vomiting, stomach problems, cough, asthma, diarrhea, fever, dysentery, arthritis, eye ailments, and back pain.

## **CHEMICAL COMPOSITION:**

Numerous phytochemicals, including as eugenol, carvacrol, linalool, ursolic acid, rosmarinic acid, and  $\beta$ -caryophyllene, are found in tulsi. Eugenol (70%) makes up the majority of its essential oil, followed by  $\beta$ -elemene (11%),  $\beta$ -caryophyllene (8%), and germacrene (2%), with traces of other terpenes. The primary components of the medicinal qualities are camphor, and eugenol. The seeds of tulsi include sitosterol and fatty acids, whereas the mucilage contains sugars, xylose, and polysaccharides. It is high in vitamins A and C, which increase the synthesis of antibodies and give antioxidants to stop cell damage and the possible development of cancer Singh et al. (2021).

## **BIOLOGICAL ACTIVITIES OF OCIMUM SPECIES:**

Plants rich in essential oils belong to the Lamiaceae family and are members of the genus *Ocimum*, often known as basil. Safety, claim validation, and product uniformity are the main issues with herbal medications. *Ocimum* oil and its components have shown a range of biological activity during the last 20 years, including antiviral, antifungal, antibacterial, antiparasitic, antioxidant, anticancer, and anti-inflammatory properties. The main source of *Ocimum sanctum* (tulsi)'s medicinal qualities is eugenol, the plant's active ingredient.

### **ANTIVIRAL ACTIVITY:**

Medicinal tulsi leaves are useful for promoting immunity, easing recuperation, and treating viral diseases like the flu and colds. In traditional medicine, bronchitis, bronchial asthma, malaria, diarrhea, dysentery, and skin disorders are all treated using various parts of the *Ocimum sanctum* Linn plant, including leaves, stem, flower, root, seeds, and the entire plant.

#### ANTIBACTERIAL ACTIVITY:

Antiprotozoal drugs, *Trichomonas vaginalis*, and both Gram-positive and Gram-negative bacteria can all be successfully combatted using Ocimum oil and its derivatives. Cell wall breakdown, cytoplasmic membrane damage, membrane protein damage, cell leakage, cytoplasmic coagulation, and proton motive force depletion are some possible mechanisms of action, while the exact mechanism behind their antibacterial activity remains unclear.

#### ANTIFUNGAL ACTIVITY:

Research has indicated that polar extracts are not as potent as essential oils derived from Ocimum species as they are as antifungals. Specifically, *Ocimum basilicum* L. essential oil suppresses the synthesis of aflatoxin B1 and shows potent in vitro antifungal activity against *Aspergillus flavus*. Linalool, 1,8-cineole, eugenol, methyl cinnamate,  $\alpha$ -cubebene, caryophyllene,  $\beta$ -ocimene, and  $\alpha$ -farnesene are the primary constituents that cause this action.

#### ANTICANCER ACTIVITY:

Ocimum oil's polyphenols have long been thought to be advantageous for avoiding several malignancies, especially among Asian cultures. More so than the oil, Ocimum leaf extract has shown potent antioxidant qualities and the capacity to stop the growth of cancer cells, indicating defense against the genotoxic consequences of reactive oxygen species. At low micromolar concentrations, methanol aqueous *Ocimum basilicum* L. leaf extract and its components, including eugenol, have demonstrated free radical scavenging action and reduced the proliferation of human breast cancer cell lines (MCF-7 and MDA-MB-231) and promyelocytic blood leukemia cells (HL60).

#### ANTI-OXIDANT ACTIVITY:

By blocking the production of new radicals, changing existing radicals into less harmful molecules, and halting radical chain reactions, antioxidants shield the body from free radical damage. Their primary role is to prevent oxidizing chain reactions from starting or continuing, which lessens oxidative damage to the human body.

#### ANTI-PARASITIC ACTIVITY:

Tulsi is useful in treating a variety of illnesses, including typhoid, malaria, and viral encephalitis. It can also prevent, treat, or lower fevers. Tulsi is acknowledged by the Imperial

Malarial Conference as an effective treatment for malaria. Periodic fevers can be treated with fresh tulsi juice and black pepper powder, while acute fevers can be lowered with a decoction made of boiling tulsi leaves, sugar, and milk powdered cardamom. Tulsi may also have an antifertility impact, lowering sperm count in men and estrogen levels in women.

#### ANTI-INFLAMMATORY ACTIVITY:

A variety of mediators, including cytokines and chemokines, are released during an inflammatory reaction, which is characterized by redness, heat, discomfort, and edema. These mediators control the influx of cells, which reduces inflammation and promotes tissue repair. On the other hand, chronic inflammation may be brought on by dysregulation or recurrent inflammatory triggers. Ocimum extracts have ingredients that may have anti-inflammatory properties. The anti-inflammatory properties of Ocimum oil phenolics on RAW 264.7 macrophage cells treated with bacterial lipopolysaccharide (LPS) were shown in a 2019 research by Aye et al. The phenolics exhibited a notable increase in nitric oxide generation in vitro, without inducing cytotoxicity, suggesting that they may have anti-inflammatory properties.

#### PHYTOCHEMICAL STUDIES:

Phytochemicals are complex molecules made up of several elements, are found in ethnomedical plants such as Ocimum species. Ocimum has been used for a long time in traditional medicine, which inspired scientists to investigate the plant to identify and isolate a variety of phytochemicals from its various sections. Alkaloids, terpenoids, tannins, flavonoids, coumarins, quinones, polyphenols, saponins, and their derivatives are a few of these.

#### *Ocimum americanum*

*Ocimum americanum* is abundant in alkaloids, phenolic compounds, tannins, lignin, saponins, flavonoids, terpenoids, and anthraquinone, according to phytochemical investigation done by Dhale et al. (2010) Similar results were also reported by Alciléia et al. (2013), who recorded the identification and isolation of several chemicals from its essential oil, including  $\alpha$ -pinene, camphene, sabinene,  $\beta$ -pinene, and  $\beta$ -myrcene.

#### *Ocimum basilicum*



*Ocimum basilicum* leaves have been shown to contain terpenes, flavonoids, cardiac glycosides, tannins, carbohydrates, and steroids, according to studies by Sanni et al. (2008) and Ismail (2006). Important bioactive chemicals like  $\alpha$ -pinene,  $\beta$ -myrcene, 4-hexen-1-ol acetate, and others were found in the leaf essential oil by Andrew et al. (2019) by chemical analysis using GC-MS. In their study report, Sarfaraz et al. (2011) also confirmed the existence of these chemicals.

### ***Ocimum gratissimum***

*Ocimum gratissimum* has been shown by Offiah (1999) and Chikwendu (2019) to contain tannins, steroids, triterpenoids, and carbohydrates. The existence of oligosaccharides, flavonoids, tannins, and alkaloids was demonstrated by Prabhu et al. (2009). Jirovetz et al., Pandey and Chowdhury, Matasyoh et al (2007) and Kéita et al (2000). have also reported on several chemicals that were extracted from *Ocimum gratissimum*.

### ***Ocimum kilimandscharicum***

Tewari et al. (2012) list the phytochemicals found in *Ocimum kilimandscharicum* as alkaloids, glycosides, saponins, flavonoids, phenols, carbohydrates, steroids, proteins, and amino acids. From its essential oil, Charles and Simon extracted seventeen chemicals, including as eugenol, camphene,  $\beta$ -pinene, and  $\alpha$ -pinene.

### ***Ocimum sanctum***

In an investigation by Xia et al. (2018) the ethanolic extract of *Ocimum sanctum* included alkaloids, terpenoids, and carbohydrates. Similar to this, Devendran and Balasubramanian reported the presence of alkaloids, carbohydrates, terpenoids, tannins, steroids, flavonoids, and cardiac glycosides. Furthermore, eugenol and caryophyllene were among the chemicals found in the hydro-alcoholic extract according to GC-MS analysis.

## **CONCLUSION:**

*Ocimum* species have been studied in great detail for their potential as therapeutics and are used extensively in traditional medicine globally. Numerous chemicals, including those with antimalarial, anticancer, antidiabetic, anti-inflammatory, and antioxidant properties, are present in these plants and contribute to their pharmacological actions. Their widespread use

emphasizes the importance of these substances in conventional medical practices, and current research indicates that these substances have promise uses in contemporary medicine. Ocimum species continue to be a focus of scientific inquiry due to their complex chemical makeup and wide-ranging medicinal qualities. These species may also provide important new information for treating a variety of health issues in many cultural and medical traditions.

## REFERENCES:

1. Naghibi, F., Mosaddegh, M., Motamed, S. M. & Ghorbani, A. Labiatae family in folk medicine in Iran: from ethnobotany to pharmacology. *Iran. J. Pharm. Res.* **4**, 63–79 (2022).
2. Štefan, M. B., Vuković Rodríguez, J., Blažeković, B., Kindl, M. & Vladimir-Knežević, S. Total hydroxycinnamic acids assay: Prevalidation and application on Lamiaceae species. *Food Anal. Methods.* **7**, 326–336 (2014).
3. Kumar, N. & Pruthi, V. Potential applications of ferulic acid from natural sources. *Biotechnol. Rep.* **4**, 86–93 (2014).
4. Kwon, K. H., Barve, A., Yu, S., Huang, M. T. & Kong, A. N. Cancer chemoprevention by phytochemicals: Potential molecular targets, biomarker sand animal models. *Acta Pharmacol. Sin.* **28**, 1409–1421 (2007).
5. Moore, J., Yousef, M. & Tsiani, E. Anticancer effects of rosemary (*Rosmarinus officinalis* L.) extract and rosemary extract polyphenols. *Nutrients* **8**, 731 (2016).
6. Frezza, C., Venditti, A., Serafini, M., and Bianco, A. (2019). Chapter 4 - Phytochemistry, Chemotaxonomy, Ethnopharmacology, and Nutraceuticals of Lamiaceae. In *Studies in Natural Products Chemistry*, Ed- Atta-ur-Rahman, Volume 62: 125-178. ISBN 9780444641854. <https://doi.org/10.1016/B978-0-444-64185-4.00004-6>
7. Asghari, G., Akbari, M., and Asadi-Samani, M. (2017). Phytochemical analysis of some plants from Lamiaceae family frequently used in folk medicine in Aligudarz region of Lorestan province, *Marmara Pharmaceutical Journal*, Vol. 21(3): 506-514. Doi: 10.12991/marupj.311815
8. Nieto, G. (2017). Biological activities of three essential oils of the Lamiaceae family. *Medicines*, **4**(3), 63.
9. Uritu, C. M., Mihai, C. T., Stanciu, G. D., Dodi, G., Alexa-Stratulat, T., Luca, A., ... & Tamba, B. I. (2018). Medicinal plants of the family Lamiaceae in pain therapy: A review. *Pain Research and Management*, **2018**(1), 7801543.
10. Padalia, Rajendra C.; Verma, Ram S. (2011). "Comparative volatile oil composition of four Ocimum species from northern India". *Natural Product Research.* **25** (6): 569–575.
11. Saha S, Dhar TN, Sengupta C, Ghosh PD. Biological activities of essential oils and methanol extracts of five Ocimum species against pathogenic bacteria. *Czech Journal of Food Science.* 2013;**31**:194-202



12. A comparative study of different crude extracts of *Ocimum sanctum* on noise stress. Archana R, Namasisvayam A *Phytother Res*. 2002 Sep; 16(6):579-80.
13. Chowdhury T, Mandal A, Roy SC, De Sarker D. Diversity of the genus *Ocimum* (Lamiaceae) through morpho-molecular (RAPD) and chemical (GC-MS) analysis. *J Gen Eng Biotech* 2017;15:275-286
14. Sandeep P. The phytochemical constituents, pharmacological and traditional uses of *Ocimum gratissimum* L in tropics. *Indo Am P Sci* 2017;4(11):4234 – 4242.
15. Nwanjo HU, Oze GO. Hypolipidaemic and antioxidant properties of *Ocimum gratissimum* on diabetic rats. *Plant Prod Res J* 2007;11:1-4.
16. Vidhya E, Vijayakumar S, Rajalakshmi S, Kalaiselvi S, Pandiyan P. Antimicrobial activity and phytochemical screening of *Ocimum americanum*L extracts against pathogenic microorganisms. *Acta Ecologica Sinica* 2020; 40(3):214-220.
17. Dhale DA, Birari AR, Dhulgande GS. Preliminary Screening of Antibacterial and Phytochemical Studies of *Ocimum americanum* Linn. *J Ecobiotechnol* 2010;2(8):11-13.
18. Ismail M. Central properties and chemical composition of *Ocimum basilicum* essential oil. *Pharmaceut Bio* 2006; 44(8):619–626.
19. Andrew BF, Felicitas EM, Emrobowansan MI, Anthony JA, Voster M. Phytochemical Constituents and Antioxidant Activity of Sweet Basil (*Ocimum basilicum* L.) Essential Oil on Ground Beef from Boran and Nguni Cattle. *Int J Food Sci* 2019;2019:1- 8.
20. Offiah VN, Chikwendu UA. Antidiarrhoeal effects of *Ocimum gratissimum* leaf extract in experimental animals. *J Ethnopharmacol* 1999;68:327-30.
21. Tewari D, Pandey HK, Sah AN, Meena HS, Manchanda A. Pharmacognostical and biochemical investigation of *Ocimum kilimandscharicum* plants available in western Himalayan region. *Asian Journal of Plant Science and Research*, 2012, 2 (4):446-451.
22. Xia KZ, Perveen N, Khan NH. Phytochemical analysis, antibacterial and antioxidant activity determination of *Ocimum sanctum*. *Pharm Pharmacol Int J* 2018;6(6):490-497.
23. Sanni S, Onyeyili PA, Sanni FS. Phytochemical Analysis, Elemental Determination and Some *in vitro* Antibacterial Activity of *Ocimum basilicum* L. Leaf Extracts. *Resear J Phytochem*, 2008;2:77-83.
24. Sarfaraz KM , Fazal UR , Muhammad SK, Said G, Naveed A, Ghulam M, Khalid U. Phytochemical Constituents and Pharmacological Activities of Sweet Basil-*Ocimum basilicum* L. (Lamiaceae). *Asian J Chem* 2011;23(9):3773-3782
25. Prabhu KS, Lobo R, Shirwaikar AA, Shirwaikar A. *Ocimum gratissimum*: A Review of its Chemical, Pharmacological and Ethnomedicinal Properties. *The Open Complem Med J* 2009;1:1-15.
26. Alcil ea NY, Renata G, Aureo TY, Expedito LS, Saulo ES, Marcio JD, M rcia MOD, Ciomar AB, Roberto KNC. Anti-inflammatory Activity of *Ocimum americanum*L. Essential Oil in Experimental Model of Zymosan-Induced Arthritis. *Am J Chin Med* 2013; 41(4): 913–926.