



PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITIES OF OCIMUM SANCTUM - A REVIEW

Gourab Saha¹, Bhagwat N. Poul², Vivek Dhir³, Rashmi Dorai⁴, Aarti Kale⁵, Deepak Singh⁶, Amit Suresh Rao Sontakke⁷, Tapas Kumar Panigrahi⁸ and Rode Tushar Arun^{9*}

¹Assistant Professor, Department of Pharmaceutics, College of Pharmaceutical Sciences, Berhampur, Odisha, India.

²Principal, Department of Pharmacy, Maharashtra Poly D Pharmacy Institute, Nilanga, Maharashtra, India.

³Director/ Assistant Professor, Department of Pharmacy, Punjab Multipurpose Medical Institute Sehna, Barnala, Punjab, India.

⁴Assistant Professor, Department of Pharmaceutical Chemistry, NIMS Institute of Pharmacy, Jaipur, Rajasthan, India.

⁵Assistant Professor, Department of Pharmacology.

⁶Principal, Department of Pharmaceutical Chemistry, MDBSSS (Pharmacy Institute), Banghusara, Dumariyadeeh, Gonda, Uttar Pradesh, India.

⁷Assistant Professor, Department of Pharmaceutical Chemistry, PRMS'S Anuradha College of Pharmacy, Chikhli Dist. Buldana, Maharashtra, India.

⁸Associate Professor, Department of Pharmaceutical chemistry, Royal College of pharmacy, Raipur, Chhattisgarh, India.

^{9*}Assistant Professor, Department of Pharmacognosy & Phytochemistry, P. Wadhvani College of Pharmacy, Yavatmal, Maharashtra, India.



***Corresponding Author: Prof. Rode Tushar Arun**

Assistant Professor, Department of Pharmacognosy & Phytochemistry, P. Wadhvani College of Pharmacy, Yavatmal, Maharashtra, India.

Article Received on 19/11/2023

Article Revised on 09/12/2023

Article Accepted on 29/12/2023

ABSTRACT

The goal of this study is to compile data on *Ocimum sanctum* Linn. (tulsi), a plant used in traditional medicine, that is related to botany, phytochemistry, ethnomedicine, pharmacology, and toxicology. *O. sanctum*'s remarkable therapeutic qualities have led to its veneration in nearly all ancient ayurvedic scriptures. It tastes strong and bitter and has a hot, airy, and dry texture. Its seeds are thought to provide a chilly impact. Tulsi has several medical uses for its roots, leaves, and seeds. *O. sanctum* is classified as an aromatic, stimulating, and antipyretic in Ayurvedic scriptures. It aggravates pitta while calming kapha and vata. It affects the human body in a variety of ways, but mostly as a cough reliever, perspiration inducer, and anorexic and dyspepsia mitigator. Numerous biological and pharmacological activities are present in *O. sanctum*, including those that are antibacterial, antiviral, antifungal, antiprotozoal, antimalarial, anthelmintic, antidiarrheal, analgesic, antipyretic, antiinflammatory, antiallergic, antihypertensive, cardioprotective, depressant of the central nervous system (CNS), memory enhancer, antihypercholesterolaemic, hepatoprotective, antiasthmatic, antithyroidic, antioxidant, anticancer, chemopreventive, radioprotective, immune-modulating, antifertility, antiulcer, antiarthritic, adaptogenic / antistress, anticataract, antileucodermal, and anticoagulant properties. This study will undoubtedly assist researchers and clinicians working with *O. sanctum* in understanding how to use it properly, since this herb appears to be quite beneficial and have several pharmacological and therapeutic qualities.

KEYWORDS: *Ocimum Sanctum*, Phytochemistry, Immunomodulator, Anti-pyretic, Analgesic.

INTRODUCTION

Potential medications may be found abundantly in the plant kingdom, and the value of medicinal plants has gained attention in recent years. Medicinal plants yield a wide range of bioactive chemicals and are a rich source of numerous medications. Medicinal extracts from plants are highly beneficial and one of the main sources of medication. They are essential for growth promotion and pathogen control.^[1] These are the more affordable sources of treatments and workable solutions for

different infections. Because medicinal plant extracts are rich in a variety of secondary metabolites, including tannins, phenolics, alkaloids, and flavonoids, which improve innate immune response, growth, and resistance to disease towards pathogenic bacteria in humans and other organisms, they have emerged as a good substitute in recent times.^[2] Approximately 80% of people in affluent nations utilize traditional medicines made from medicinal plants, such as antifungal, anticancer, and antibacterial agents,^[3] among others. Secondary

metabolites, which are incredibly varied chemically and taxonomically with unknown functions, are abundant in therapeutic plants. A large number of phytochemicals are widely used in human therapy, agriculture, veterinary, various scientific researches and in different areas^[4] along with inhibitory effects on all types of microorganisms *in vitro*.

An essential part of Hindu religious heritage is the tulsi plant. While the word "Tulsi" implies the exceptional, its other name, Vishnupriya, refers to the one who pleases Lord Vishnu. Its tale has permeated Indian culture throughout the millennia, and it is revered and found in most Indian homes. Tulsi, botanically known as *Ocimum sanctum* and known as Holy Basil in English, is a member of the Lamiaceae family of plants. Because it has so many medical characteristics, it has contributed much to science both historically and in the present. There are two forms of tulsi: gramya, which is cultivated in houses, and vanya, which is found in the wild. The first variety has darker leaves, even with the same use. Tulsi is a well-liked over-the-counter treatment for a wide range of conditions, including wounds, bronchitis, liver problems, Catarrhal fever, ocular, gastrointestinal, genitourinary, skin, and psychological stress disorders.

Along with these qualities, it also possesses demulcent, diaphoretic, diuretic, expectorant, vermifuge, febrifuge, aromatic, stomachic, and carminative qualities. A review of the varied pharmacological actions of OS based on experimental and clinical investigations published in various literatures has been attempted in light of these findings. In warm climates and the tropics, tulsi grows wild. The plant is grown and supplied across India. Ancient literature describes Tulsi as a holy and healing plant. "Matchless one" is how the Sanskrit word "Tulsi" is obtained. This plant is a member of the Labiatae family and is distinguished by its square stem and distinct scent. *Ocimum sanctum* is the botanical name for Tulsi (Linn). From the Andaman & Nicobar islands to the Himalayas, where it reaches elevations of up to 1800 meters above sea level, the plant is grown all throughout India. In addition, Malaysia, Australia, West Africa, and a few Arab nations are rich in it. Of the genus, *Ocimum sanctum* (Linn) is one of the most well-known species. The plant's leaves are revered greatly and are frequently used in Hindu spiritual ceremonies known as tirtha or prāsada. The chemical components of the two types of *Ocimum sanctum*—black (Krishna Tulsi) and green (Rama Tulsi)—are comparable. Additionally, both types have similar therapeutic qualities.^[5-7]

Taxonomy^[8]

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Lamiales
Family	Lamiaceae
Genus	<i>Ocimum</i>
Species	<i>O. sanctum</i>

Vernacular names^[9]

English	Basile, Sweet Basil
Hindi	Besil, Tulsi, Jangli tulsi
West Bengal	Tulsi, Kalotulsi, Kural
Himachal Pradesh	Tulsi, Niyam Posh
Gujarat	Sabje, Talasi
Karnataka	Karitulasi, Tulasiya
Kerala	Pachcha, Kunnakam
North-eastern India	Mayangton, Naoshek lei
Maharashtra	Sabja, Tulasa
Orissa	Dhala tulasi, Karpura
Punjab	Tulsi
Tamilnadu	Tiruttizhai, Tiviragandam
Andhra Pradesh	Oddhi, Rudrajada
Kashmir, North India	Tulsi, Janglitulsi

Botanical description

When fully grown, tulsi is an upright, aromatic plant with branches that may reach heights of 30 to 60 cm. Tulsi leaves have a complete edge and are simple, inverted, elliptical, ovoid, thick, or acute. The leaves can

reach a length of 5 cm. Its petiole is 2–5 cm long, thin, and hairy, and it has a modest phyllotaxy. The plant's primary medicinal component is found in its leaves. They have tiny glands and are pubescent on both sides. Although they are sporadically seen on the upper side of

the leaf, stomata are present on its bottom surface. This plant produces purple- to pink-colored verticillaster inflorescences as its blooms. The flowers have a solitary or branching raceme that is 5 to 30 cm tall, sessile, ovate, caduceus, hermaphrodite bracts, and a pedicel that is 1-4 mm long and either spreading or slightly curved. After 136 days, flowering began and continued for another 195 days. Their seeds matured after 259 days. Fruit with four dry, one seeded nutlets wrapped in a persistent calyx; the exterior pericarp, which is up to 1.5 mm long and rugose brown, does not become mucilaginous when submerged in water. Small, reddish-black seeds are produced by this plant. When a plant is young, its stems are green; as it ages, it turns woody. Eugenol is among the essential oils found in *Ocimum sanctum* roots.^[10-13]

Phytochemical constituents

Ocimum sanctum leaves are said to be an excellent reservoir of volatile oil with a level of eugenol (71%) & methyl eugenol (20%). Sesquiterpene hydrocarbon caryophyllene and carvacrol are also present in the volatile oil. Fatty acids, phenolics, flavonoids, and terpenoids are the additional chemical components that are present. The plant's seeds are enhanced with β -sitosterol, polysaccharides, mucilage, and fixed oil (18–22%). The primary ingredient in seed oil is thought to be linoleic acid.^[14] The remaining chemical components that are there are:

S. N.	Chemical constituents ^[9]
1	Phenolics: Chlorogenic acid, Vanillic acid, Ocimumnaphthanoic acid, Caffeic acid and Menthylsalicylic acid
2	Flavonoids: cirsumaritin, crisilineol, isothymusin, gardenin, apigenin, eupatorin and salvigenin
3	Terpenoids: β -caryophyllene, elemene, α - humulene, α -caryophyllene, germacrene, trans- α -bergamotene and 5 β - hydroxycaryophyllene
4	Coumarins: aeculetin, aesculin and ocimarin
5	Phenyl propanoids derivatives: Eugenol, ociglycoside or eugenyl- β -D-glucoside, feruldehyde, citrusin C and dehydrodieugenol
6	Neolignans: Tulsinol A to Tulsinol G
7	Steroids: β -sitosterol, β -sitosterol-3-O β -D glucopyranoside, stigmasterol and campesterol

Traditional uses

Tulsi is also known as "the elixir of life" since it promotes longevity. Ayurvedic and Siddha medical systems use various parts of the plant to prevent and treat a wide range of illnesses and common ailments, including fever, earache, cough, influenza, sore throat, bronchitis, asthma, hepatic diseases, malarial fever, fatigue, skin diseases, flatulence, migraine headaches, fatigue, wounds, insomnia, arthritis, digestive disorders, night blindness, and diarrhoea. The leaves help to calm tensions and improve memory. Chewing tulsi leaves also treats oral infections and ulcers.^[15] A few leaves thrown into food or drink can destroy bacteria and cleanse the water. Holy basil has a powerful immune-boosting effect. It offers defense against almost all types of infections caused by bacteria, fungus, viruses, and protozoa. According to recent research, it also helps prevent the spread of HIV and cancer-causing cells.^[16]

Pharmacological activities

1. Analgesic: It has been claimed that the *Ocimum sanctum* plant's oil has analgesic properties. Using tail flick, tail clip, tail immersion, and acetic acid-induced writhing, mice were used in this investigation. According to the findings, acetylcholine, histamine, and prostaglandin all work together to have an inhibitory impact, which accounts for the oil's inhibitory function.^[17]

2. Antipyretic activity: The effectiveness of OS fixed oil as an antipyretic was assessed by subjecting rats to typhoid-paratyphoid A/B vaccine-induced pyrexia. When administered intraperitoneally, the oil significantly lowered the fever response, suggesting that it has antipyretic properties. The oil's antipyretic effect was similar to aspirin at a dosage of 3 ml/kg. Moreover, the prostaglandin inhibitory action of the fixed oil may account for its antipyretic properties.^[17]

3. Anti-inflammatory: The tulsi plant has anti-inflammatory properties due to its fatty acid content. Linoleic acid is the primary fatty acid that exhibits anti-inflammatory properties; it has the ability to obstruct the routes of lipoxygenase and cyclooxygenase.^[18]

4. Antioxidant effect: The extract from *O. sanctum* enhanced antioxidants such as decreased glutathione (GSH) levels in rat plasma, liver, lung, Kidney and Brain.^[19]

5. Immunomodulatory activity: A steam-distilled extract of fresh OS leaves was shown to alter the humoral immune response in albino rats. This alteration might be explained by many methods, including the generation of antibodies, the release of mediators of hypersensitive reactions, and the target organs' tissues' responses to these mediators.^[20] Immune response to humoral and cell-mediated

stimuli appears to be modulated by OS seed oil, and these modulatory effects may be mediated by GABAergic pathways.^[21]

6. **Hepatoprotective activity:** In male Wistar albino rats, oral treatment of 200 mg/kg hydro-ethanolic extract of OS leaves provided protection against paracetamol-induced liver damage. It was shown that OS cold water extract (3 g/100 g, taken orally for 6 days) was efficient in protecting albino rats' livers towards carbon tetrachloride (0.2 ml/100 g, applied subcutaneously). Tulsi provided liver protection against a range of damages caused by experimentation.^[22]
7. **Antidiabetic activity:** In streptozotocin-induced diabetic rats and normal, glucose-fed hyperglycemic rats, oral treatment of OS extract resulted in a significant reduction in blood sugar levels.^[23] Significant reductions in fasting and postprandial blood glucose levels were seen in a randomized, placebo-controlled, cross-over single blind human experiment (17.6% and 7.3%, respectively). The trend in urine glucose levels was comparable.^[24] Moreover, OS possesses aldose reductase activity, which might aid in lowering diabetic consequences including retinopathy and cataracts.^[25]
8. **Antitussive:** According to a research, guinea pig studies revealed that the aqueous and methanolic extracts of the OS plant had antitussive action.^[26]
9. **Antiemetic:** Tulsi leaves are said to have antiemetic qualities and are used to alleviate diarrhea caused by vomiting.^[27]
10. **Memory enhancer:** Rats were used to test the aqueous and alcoholic extracts of *O. sanctum* leaves for their antidementia and anticholinesterase properties. Dementia was induced by electroshock, cyclosporine, and atropine. The inactive constraint was reportedly employed to evaluate memory.^[28]
11. **Anticancer activity:** *O. sanctum* leaf extracts, both alcoholic and aqueous, were tested for their anticholinesterase and antidementia effects in rats. Atropine, cyclosporine, and electroshock all caused dementia. It has been stated that the inactive restriction was used to test memory.^[28]
12. **Antidepressant and Antianxiety:** Swiss mice were used to evaluate the *O. sanctum* ethanolic extract. The plant extract was shown to have antidepressant and antianxiety qualities, and it may be used as a medication to treat these conditions.^[32]

CONCLUSION

Indians employ herbal plants for their great value in treating and healing a wide range of diseases. The herb tulsi, or *Ocimum sanctum*, is revered. It is mostly used as

a herbal tea and for medical purposes. It is a part of the Greek, Roman, Unani, Ayurvedic, and Sidha medical systems. Numerous studies have documented the medicinal benefits of the *Ocimum sanctum* plant, which include antiulcer, antistress, antifertility, antiasthmatic, analgesic, antidiabetic, antioxidant, antibacterial, and neuroprotective qualities. Shown from numerous, ongoing scientific investigations that the tulsi herb has enormous therapeutic value and is used to treat a wide range of illnesses all across the world.

Conflict of interest

The authors declare that the review was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Acknowledgement

The authors are thankful to their institutes.

Funding

None.

REFERENCES

1. Doss, A., Preliminary phytochemical screening of some Indian medicinal plants. *Ancient Science of Life*, 2009; 29(2): 12-16.
2. Edoga, H.O., Okwu, D.E., Mbaebie, B.O. Phytochemicals constituents of some Nigerian medicinal plants. *African Journal of Biotechnology*, 2005; 4(7): 685-688.
3. Dewick, P.M., *Tumor inhibition from plants: Tease and Evans*. Pharmacognosy, 1996.
4. Vasu, K., Goud, J.V., Suryam, A., Singara and Chary, M.A., Biomolecular and phytochemical analyses of three aquatic angiosperms. *African Journal Microbiology Research*, 2009; 3(8): 418-421.
5. Das SK and Vasudevan DM. Tulsi: The Indian holy power plant. *Natural Product Radiance*, 2006; 5: 279-83.
6. Prajapati ND, Purohit SS, Sharma AK and Kumar T. *A Hand Book of Medicinal Plant*. Agrobios, India, 2003; 367.
7. Gupta SK, Prakash J and Srivastava S. Validation of traditional claim of Tulsi,
8. *Ocimum sanctum* Linn. as a medicinal plant. *Indian J Exp Biol*, 2002; 5: 765-773.
9. Verma S. Chemical constituents and pharmacological action of *Ocimum sanctum* (Indian holy basil-Tulsi). *J Phytopharmacol*, 2016; 5(5): 205-207.
10. Thakur S, Choudhary S, Walia B et.al. Tulsi - a review based upon its ayurvedic and modern therapeutic uses. *International Journal of Research and Review*, 2021; 8(5): 263-272. DOI: <https://doi.org/10.52403/ijrr.20210534>
11. Sembulingam K, Sembulingam P, Namasivayam A. Effect of *Ocimum sanctum* Linn on noise induced changes in plasma corticosterone level. *Indian Journal of Physiology and Pharmacology*, 1997; 1, 41: 139-43.

12. Warriar PK, Nambiar VP, Ramankutty C. Indian medical plants, 1995.
13. Kothari SK, Bhattacharya AK, Ramesh S, Garg SN, Khanuja SP. Volatile constituents in oil from different plant parts of methyl eugenol-rich *Ocimum tenuiflorum* Lf (syn. *O. sanctum* L.) grown in South India. *Journal of Essential Oil Research*, 2005; 1, 17(6): 656-8.
14. Godhwani S, Godhwani JL, Was DS. *Ocimum sanctum*—a preliminary study evaluating its immunoregulatory profile in albino rats. *Journal of Ethnopharmacology*, 1988; 1, 24(2-3): 193-8.
15. Naji-Tabasi S, Razavi SM. Functional properties and applications of basil seed gum: An overview. *Food Hydrocolloids*, 2017.
16. Prajapati N.D., Purohit S.S., Sharma A.K. and Kumar T.A. Hand book of medicinal plant. Agrobios, India, 2003; 367.
17. Kumar PK, Kumar MR, Kavitha K, Singh J and Khan R. Pharmacological actions of *Ocimum sanctum*— review article. *Int J Adv Pharm Biol Chem*, 2012; 1: 406-414.
18. Singh S, Majumdar DK. Analgesic activity of *Ocimum sanctum* and its possible mechanism of action. *International journal of Pharmacognosy*, 1995.
19. Singh S, Majumdar DK. Evaluation of antiinflammatory activity of fatty acids of *Ocimum sanctum* fixed oil. *Indian Journal of Experimental Biology*, 1997.
20. Hussain, E.H.M.A. and Jamil, Rao, M. Hypoglycemic, hypolipidemic and antioxidant properties of Tulsi (*Ocimum sanctum*) on streptozotocin induced diabetes in rats. *Indian J. of Clin. Biochemistry*, 2001; 16(2): 190-194.
21. Singh S, Malhotra M, Majumdar DK. Antibacterial activity of *Ocimum sanctum* L. fixed oil. *Indian J Exp Biol*, 2005; 43: 835.
22. Mediratta PK, Dewan V, Bhattacharya SK, Gupta VS, Maiti S, Sen P. Effect of *Ocimum sanctum* Linn. on humoral immune responses. *Indian J Med Res*, 1998; 87: 384.
23. Chattopadhyay RR, Sarkar SK, Ganguly S, Medda C and Basu TK. Hepatoprotective activity of *O. sanctum* leaf extract against paracetamol induced hepatic damage in rats. *Indian J Pharmacol*, 1992; 24: 163.
24. Khanna S, Gupta SR, Grover JK. Effect of long term feeding of Tulsi (*Ocimum sanctum*) on reproductive performance of adult albino rats. *Indian J Exp Biol*, 1986; 24: 302.
25. Chattopadhyay RR. Hypoglycemic effect of *Ocimum sanctum* leaf extract in normal and streptozotocininduced diabetic rats. *Indian J Exp Biol*, 1993; 31: 891893.
26. Agrawal P, Rai V, Singh RB. Randomized placebo controlled, single blind trial of holy basil leaves in patients with noninsulin dependent diabetes mellitus. *Int J Cli Pharmacol Ther*, 1996; 34: 406.
27. Nadig P, Laxmi S. Study of anti-tussive activity of *Ocimum sanctum* Linn in guinea pigs. *Indian journal of physiology and pharmacology*, 2005.
28. Kumar V, Andola HC, Lohani H, Chauhan N. Pharmacological review on *Ocimum sanctum* Linnaeus: a queen of herbs. *J of Pharm Res*, 2011.
29. Giridharan VV, Thandavarayan RA, Mani V, Ashok Dundapa T, Watanabe K, Konishi T. *Ocimum sanctum* Linn. leaf extracts inhibit acetylcholinesterase and improve cognition in rats with experimentally induced dementia. *Journal of medicinal food*, 2011.
30. Nakamura C V, Ishida K, Faccin L C, Filho B P D, Cortez D A G, Rozental S, de Souza W and Ueda-Nakamura T. *In vitro* activity of essential oil from *Ocimum gratissimum* L. against four *Candida* species. *Research in Microbiology*, 2004; 155(7): 579-586.
31. Monga J., Sharma M., Tailor N. and Ganesh N. Antimelanoma and radioprotective activity of alcoholic aqueous extract of different species of *Ocimum* in C (57) BL mice. *Pharm Biol*, 2011; 49: 428-436.
32. Panda S and Kar A. *Ocimum sanctum* leaf extract in the regulation of thyroid function in the male mouse. *Pharmacol Res*, 1998; 38(2): 107– 110.
33. Chatterjee M, Verma P, Maurya R, Palit G. Evaluation of ethanol leaf extract of *Ocimum sanctum* in experimental models of anxiety and depression. *Pharmaceutical biology*, 2011.