



**INTERNATIONAL JOURNAL OF  
PHARMACEUTICAL SCIENCES**  
[ISSN: 0975-4725; CODEN(USA): IJPS00]  
Journal Homepage: <https://www.ijpsjournal.com>



## Review Article

# Pharmacological and Therapeutic Potential of *Ocimum sanctum*: A Comprehensive Review of its Traditional Uses and Modern Applications

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## ARTICLE INFO

Published: 05 Jun. 2025

### Keywords:

*Ocimum sanctum*,  
Phytochemicals, Traditional  
Medicine, Antimicrobial  
Activity, Adaptogenic Herb

### DOI:

10.5281/zenodo.15597452

## ABSTRACT

*Ocimum sanctum* L., is a revered medicinal herb that has long been an integral part of the Ayurvedic and Siddha medical traditions. Tulsi, sometimes called the "Queen of Herbs," has a long list of beneficial health effects, such as reducing inflammation, fighting cancer, lowering blood sugar, and promoting adaptogenic growth. Due in great part to its rich phytochemical content, which includes phenolic substances (rosmarinic acid, cirsilinoleol), triterpenoids (ursolic acid, oleanolic acid), essential oils (eugenol, carvacrol, methylchavicol), and flavonoids (orientin, vicenin, apigenin). In the past, people have turned to Tulsi for relief from a wide range of medical conditions, including infections of the respiratory tract, gastrointestinal issues, stress, skin illnesses, and more. Research has shown that it is effective compared to several pathogens, including *Staphylococcus aureus*, *E. coli*, and *Candida albicans*, and has also confirmed many of its traditional uses. Its potential for chemoprevention and radioprotection is further enhanced by its ability to modulate enzymes like cytochrome P450 and glutathione S-transferase, which in turn have anti-cancer effects. In addition to its medicinal applications, Tulsi plays a role in environmental purification and vector control, particularly in repelling mosquitoes. The plant's therapeutic properties are influenced by factors such as cultivation conditions, storage, and preparation methods. Overall, *Ocimum sanctum* serves as a potent, multi-functional medicinal herb with significant clinical and pharmacological relevance, meriting further exploration and integration into modern therapeutics.

## INTRODUCTION

Holy basil, or *Ocimum sanctum* L. (Labiatae) as it is known in Indian languages, and Tulsi, another name for the plant, have both extensive medical

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**Relevant conflicts of interest/financial disclosures:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



uses in Ayurvedic medicine. Its widespread cultivation in Southeast Asia attests to its membership in the Lamiaceae family. The many medicinal uses of tulsi have earned it the title of "Queen of Herbs." Cough, cold, fever, gastrointestinal issues, and stress are just some of the traditional uses for Tulsi. As a result of its pharmacological actions, which include antioxidant, anti-inflammatory, antibacterial, anti-cancer, anti-diabetic, and adaptogenic effects, modern scientific study has confirmed numerous of its traditional uses. Eugenol, ursolic acid, flavonoids, and essential oils are just a few of the phytochemicals that provide this plant its medical benefits. Wounds, bronchitis, liver problems, catarrhal fever, ophthalmia, lumbago, hiccups, genitourinary disorders, skin illnesses, different poisonings, and psychological stress disorders are just a few of the many medical conditions that tulasi can effectively treat as a home medicine. The leaves include essential oils such as limonene, caryophylline, eugenol, carvacrol, methylchavicol, and eugenal. The seed oil contains fatty acids and sitosterol. Three triterpenes—A, B, and C—and sitosterol are found in the roots. Tulsi is a medical and spiritually significant plant that is widely cultivated in India. Its adaptogenic properties have made it useful for many people in times of high mental and physical stress, as well as for adjusting to new environments. This plant possesses antimicrobial and analgesic properties, as demonstrated by toxicological studies. Tulasi is the ideal vitamin for canines. Included in the essential oil are limatol, caryophylline, methylchavicol, and carvacrol. The seeds are rich in sitosterols and fatty acids. The roots include triterpenes A-C and sitosterol. The leaves contain the N-triacontanol. In Ayurvedic medicine, tulsi is a common medicinal herb. Its antibacterial characteristics make it a popular choice for treating a range of systemic diseases. Yet, studies examining the

effects of Tulsi on the bacteria responsible for oral illnesses are scarce. As a result, scientists looked into how Tulsi affected a periodontal microbe found in people's dental plaque. There are innumerable medicinal and health-promoting plants in the eastern world, but few are as revered as Tulsi, the Queen of plants and the legendary "Incomparable-one" in India. In ancient holistic herbal medical systems of Ayurveda and Unani, the sacred basil, Tulsi, played an important role in addition to its religious and spiritual sanctity. The classic text of Ayurvedic medicine, the Charaka Samhita, cites its therapeutic benefits. People place a high value on the tulsi herb due to its numerous complex therapeutic properties. Tulasi leaves are commonly utilized in the Ayurvedic medicine making process. It has a reputation for increasing longevity. Colds, irritability, gastrointestinal illnesses, heart conditions, migraines, indigestion, kidney stones, stomach issues, and many more maladies can be alleviated by using the plant's extracts. The Indian basil plant tulsi also helps with cleaning up the environment. In the fight against flies, mosquitoes, and creepy crawlies, the tulsi plant is an excellent repellent (Warrier 1995). Efforts to control malaria must prioritize this. Legend has it that the workers at Victoria Cultivates in Bombay (now Mumbai) endured endless jungle fever and became survivors of mosquito nibbles during the time of the establishment of the colony. Some of the Hindu supervisors, upon witnessing the workers' misery, suggested that the nursery be transformed into a Tulsi manor. Successful results were achieved after implementing their suggestion. Tulsi has a complex chemical makeup that includes several nutrients and other chemicals with biological activity. Time, cultivation method, and storage conditions all have a major impact on these components. Numerous functions are performed by the Tulsi plant. The restorative properties of tulsi leaves make them a popular



remedy. Being a stimulant for the senses, it significantly improves memory clarity. The tulsi plant, which is said to alleviate respiratory issues. Asthma, influenza, and bronchitis are all effectively treated with a mixture of honey, ginger, and tulsi leaves.

Traditional uses:

One such name for Tulsi is "the elixir of life" because of its life-extending properties. Ayurvedic and Siddha medicine utilize various plant parts to treat and prevent numerous common illnesses. These include: typical colds, discomfort, wheezes, fever, colic pain, throat irritation, bronchitis, asthma, liver disease. diseases, malaria fever, bloating, migraine headaches, fatigue, skin diseases, wounds, sleep deprivation arthritis, digestive disorders, night blindness, diarrhea, and influenza. Use these leaves to alleviate stress and improve memory.



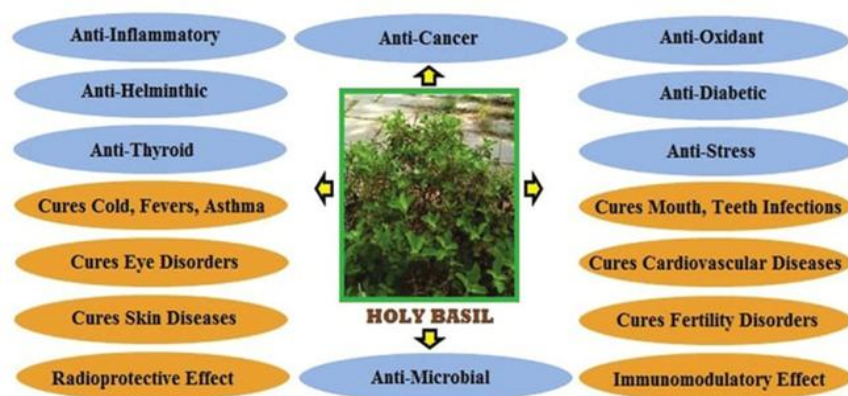
**Fig 1: Plant of Ocimum sanctum**

**Biological Source:**

The leaves of the Ocimum plant, including Ocimum basilicum L. and Ocimum sanctum L., are part of tulsi.

**Medicinal Properties of Tulsi:**

Tulsi, also known as Holy Basil, has a long list of well-deserved medical accolades, including its ability to fight infections, fevers, and fungal infections; it also acts as an antioxidant and antiseptic. Additionally, it has anti-inflammatory, anticancer, and adaptogenic effects. Tulsi has a rich history of use in Ayurvedic medicine, where it is recommended for a range of ailments, including as respiratory disorders, digestive problems, and to enhance overall health and immunity. Holy basil and its medicinal use. You may be surprised to learn that tulsi has a long list of potential medicinal benefits, including those against cancer, inflammation, oxidative stress, diabetes, and microbes.



**Fig 2: Medicinal Properties of Tulsi**

## Chemical constituents of Tulsi:

Among the many chemical components found in Tulsi—or Holy Basil (*Ocimum sanctum*)—are essential oils, flavonoids, phenolics, and terpenoids. Eugenol, linalool, carvacrol, and caryophyllene are all important components. The antibacterial, anti-inflammatory, and antioxidant effects of Tulsi are due in part to these chemicals. Tulsi has a complex chemical makeup that includes several nutrients and other chemicals with biological activity. Numerous antioxidant phenolic components, such as cirsilineol, eugenol, isothymusin, circimaritin, apigenin, and rosameric acid, were identified in an examination of *Ocimum sanctum* extract derived from greenery and stems. About 71% of the volatile oil in OS leaves is eugenol, whereas 20% is methyl eugenol. The total amount of volatile oil in OS leaves is 0.7%. In addition to carvacrol and sesquiterpene hydrocarbons, the oil also contains caryophyllene. *Ocimum sanctum*'s andvicenin and orientin flavonoids were isolated from an aqueous leaf extract.

## Essential oil:

Essential Oils: Eugenol is a vital component that has anti-inflammatory, analgesic, and antibacterial properties. Linalool is a type of terpene that can reduce inflammation, discomfort, and inflammation-related symptoms. Carvacrol is a phenol that has antimicrobial, antifungal, and antioxidant properties. Caryophyllene is a sesquiterpene that has anti-inflammatory and

antioxidant qualities. Among the flavonoids are apigenin and others. are anti-inflammatory and antioxidant. The phenols: Strong antioxidants include rosmarinic acid. The anti-inflammatory and antioxidant qualities of tulsi are attributed to additional phenolic chemicals. Other Ingredients: Triterpenoids: These include ursolic acid and oleanolic acid. They may have anti-inflammatory and other medicinal activities. A special class of substances included in tulsi are called neolignans, which include tulsinol A-J. Tulsi contains carbohydrates, saponins, and tannins as well.

## Flavonoids:

- Apigenin and other flavonoids: antioxidant and anti-inflammatory

## Phenolics:

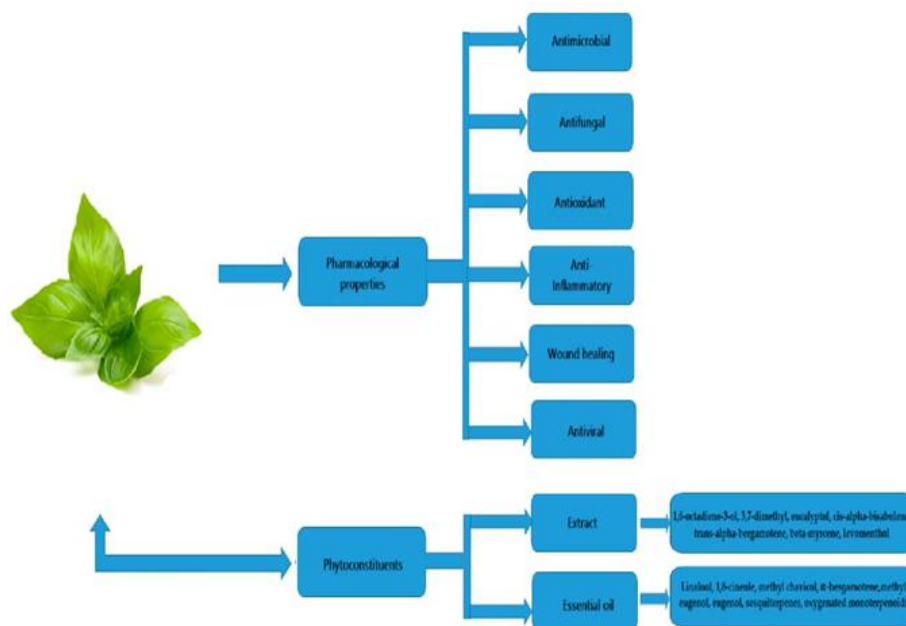
- Rosmarinic acid: antioxidant.
- Other phenolic compounds: antioxidant and anti-inflammatory

## Other Constituents:

- Triterpenoids (e.g., ursolic acid, oleanolic acid): anti-inflammatory and other therapeutic effects.
- Neolignans (e.g., tulsinol A-J): A unique family of compounds found in Tulsi.
- Carbohydrates, saponins, and tannins: Also present in Tulsi.

## Pharmacological activity of Tulsi:

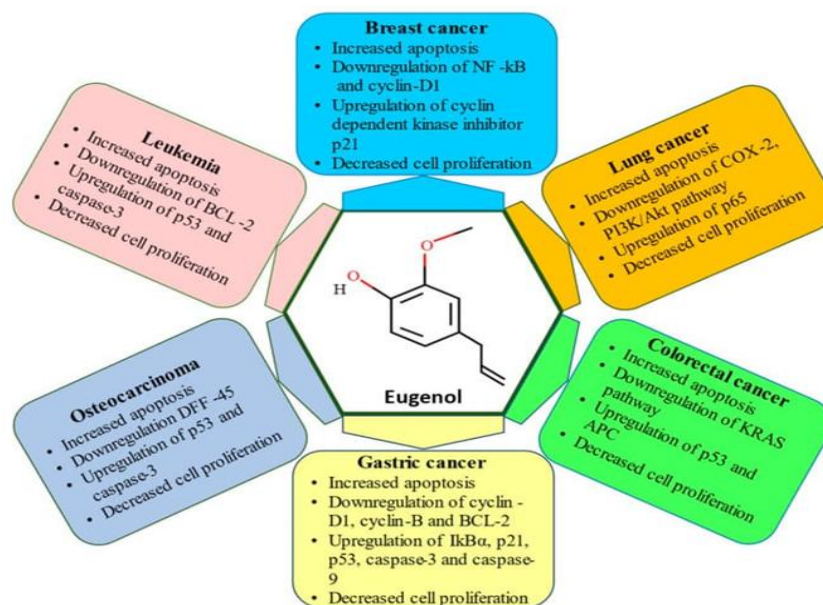




### Anti-cancer activity:

A large number of studies have verified and referenced OS's anticancer effectiveness. The glutathione S-transferase (GST), aryl hydrocarbon hydroxylase, cytochrome P 450, and cytochrome bs are all enzymes that the alcoholic extract (AIE) of OS leaves modulates. Ocimum may prevent radiation damage to the body's DNA. The conventional methods of tumor removal, which include radiation, chemotherapy, and surgery, can be quite costly, damaging to the patient's health, and accompanied with serious adverse consequences. Relapses and residual morbidity are also associated with them. Traditional

medical herb tulsi is respected across India for its adaptogen properties, which aid the body and mind in adapting to and managing various physical, mental, and stress-related situations. One of the main killers in the modern world is cancer. Surgery, radiation, and chemotherapy are all viable cancer treatment options; nevertheless, they are expensive, fraught with adverse effects, and leave patients with a residual morbidity. As a result of its antioxidant characteristics, it has the ability to prevent cancer and significantly shrink tumors. Administration to the salivary glands of rats allowed researchers to study the radio-protective impact and compare it with that of amifostinepre, a radio protectant.



**Fig 3. Anticancer effect of eugenol different type of cancer**

#### **Antimicrobial activity:**

Klesbiella, E. coli, Proteus, and Staphylococcus aureus were all inhibited in growth by AqE of OS, but Vibrio cholerae was inhibited in growth by AIE of OS. One way to find out if Ocimum sanctum (Linn.) extract is antimicrobial is to utilize the agar well-diffusion method. Dimethyl sulfoxide served as the negative control and 0.2% chlorhexidine as the positive control. Millimeters were used to measure the inhibitory zone using Vernier callipers. A separate study indicated that Aeromonas hydrophila, Enterococcus faecalis, Klebsiella pneumoniae, Candida albicans, Proteus spp., E. coli, S. Aureus, P.aeruginosa, Shigella spp., and Tulsi leaves had antibacterial and antifungal properties. There is an inhibitory action against Vibrio cholerae in the alcohol extract of Tulsi leaves. Maintaining healthy blood sugar levels is the primary function of this active component. Insulin secretion is enhanced because it regulates pancreatic beta cell activity. In India, Ocimum sanctum outperformed other Ocimum species, including O. canum, O. gratissimum, and O. basilicum, in terms of antimicrobial activity. In addition to showing promising antimicrobial

effects against several clinical isolates and multi-drug resistant bacteria, Tulsi's aqueous, alcoholic, and seed oils have demonstrated antibacterial capabilities against enteric pathogens 5061. Staphylococcus gonorrhoeae The ethanolic extracts have the ability to suppress clinical isolates of two forms of B-lactamase-producing bacteria, methicillin-sensitive Staphylococcus aureus (MRSA) and methicillin-resistant Staphylococcus aureus (MRSA).

#### **Antioxidant activity:**

Many studies have shown that OS has antioxidant capabilities. Antioxidant and associated with membrane protection, flavonoids have recently come to light. Orientin and vicenin, two flavonoids, drastically decreased radiation-induced lipid peroxidation in the livers of mice, demonstrating their antioxidant activity in vivo. OS extract is a powerful antioxidant that neutralizes highly reactive free radicals. The powerful antioxidants found in ocimum sanctum shield cells from oxidative stress and free radicals. Polyphenol One potent antioxidant found in Tulsi's chemical makeup is Rosmarinic acid. The

phenolic components found in fresh leaves and stems OS extract, including apigenin, cirsimaritin, cirsilinoleol, isothymusin, and rosmarinic acid, as well as significant amounts of eugenol (a key component of the volatile oil), demonstrated strong antioxidant properties. Asthma, cough, diarrhea, fever, arthritis, stomach disorders, indigestion, dysentery, and other gastrointestinal issues are among the many physical and mental health issues that this plant is said to alleviate in Ayurvedic medicine.

#### **Anti-inflammatory activity:**

Anti-inflammatory properties: Tulsi's chemical makeup is quite complex, with a wealth of nutrients and other physiologically active substances. These components change dramatically over time, during the cultivation process, and during storage. 500 mg/kg of tulsi paste was found to have an 88.15% anti-inflammatory response, which is the same as the reaction seen with 100 mg/kg of indomethacin. *Ocimum sanctum*, also referred to as tulsi, has anti-ulcer properties through a number of methods, such as boosting antioxidant capacity, minimizing mucosal damage, and maybe functioning as a cytoprotective agent as opposed to an antisecretory one. Studies have demonstrated that *Ocimum sanctum* can shield rats from ulcers caused by ethanol, stress, and aspirin, among other forms of stimuli.

#### **Antiulcer activity:**

*Ocimum sanctum*, commonly known as Tulsi, exhibits anti-ulcer activity through several mechanisms, including enhancing antioxidant potential, reducing mucosal damage, and potentially acting as a cytoprotective agent rather than an antisecretory agent. Studies have exposed that *Ocimum sanctum* can protect against various

types of induced ulcers, such as ethanol-induced, stress-induced, and aspirin-induced ulcers in rats.

### **CONCLUSION**

*Ocimum sanctum* L. (Tulsi), revered as the "Queen of Herbs," is a potent medicinal plant with a rich history in traditional Ayurvedic and Siddha medicine. Its wide range of therapeutic applications is attributed to its complex phytochemical composition, which includes essential oils (eugenol, carvacrol), flavonoids (apigenin, orientin, vicenin), phenolic compounds (rosmarinic acid, cirsilinoleol), and triterpenoids (ursolic and oleanolic acid). Tulsi exhibits diverse pharmacological activities such as antioxidant, antimicrobial, anti-inflammatory, anticancer, anti-diabetic, adaptogenic, and anti-ulcer properties. Scientific evidence supports its traditional use in treating respiratory conditions, digestive disorders, infections, stress-related illnesses, and even as a chemopreventive and radioprotective agent in cancer therapy. Its antimicrobial efficacy against a broad spectrum of pathogens, including *Staphylococcus aureus*, *E. coli*, and *Candida albicans*, reinforces its role in combating infectious diseases. Furthermore, Tulsi contributes to environmental purification, acts as a natural insect repellent, and supports general well-being through immune modulation. Its adaptogenic properties help the body manage physical, chemical, and emotional stress. However, the plant's therapeutic efficacy can vary significantly with cultivation methods, storage, and preparation techniques. In conclusion, *Ocimum sanctum* is not only a cornerstone of traditional herbal medicine but also a promising candidate for modern therapeutic applications. Continued pharmacological research and clinical validation are essential for fully integrating Tulsi into contemporary medicine and maximizing its potential benefits for human health.



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**HOW TO CITE:** Digambar Patil, Ranjit Patil, Shivkumar Padalkar, Pranjali Patil, Swapnanjali Pituk, Vikas Dhole, Pharmacological and Therapeutic Potential of *Ocimum sanctum*: A Comprehensive Review of its Traditional Uses and Modern Applications, *Int. J. of Pharm. Sci.*, 2025, Vol 3, Issue 6, 755-763. <https://doi.org/10.5281/zenodo.15597452>