# *Ocimum tenuiflorum* – A Medicinal Plants with its versatile uses

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## ABSTRACT

From Vedic period countries like India and Nepal are using crude plants as medicine. In Developing Countries a major portion of the total population still uses the traditional medicines which are obtained through the plant resources. According to the estimation of WHO that 80% of world population of the rural areas are dependent over the herbal traditional medicines as their primary health care, thus the study on the properties and uses of these natural medicinal plants resources are getting interest for the area of research. These medicinal plants are rich in the secondary metabolites, which are considered as the rich sources of the drugs and essential oils of therapeutic importance. One such plant of interest is *Ocium Tenuiflorum* also known as *Ocimum sanctum, Holi Basil*, or *Tulasi*. Traditionally used since the times of ancient civilization in India and called as the "Queen of Herbs". It contains 7.0% eugenol, carvacrol (3%) and eugenol-methyl ether (20%). It also contains caryophyllin, ursolic acid, rosmaric acid, thymol, methyl chavicol, citral, carvacrol, β-caryophyllene.

**Keywords**: *Ocium Tenuiflorum, Ocimum sanctum, Holi Basil, Tulasi*

## Introduction

Medicinal plants have been identified and used throughout human history. Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions, and to defend against attack from predators such as insects, fungi and herbivorous mammals. At least 12,000 such compounds have been isolated so far; a number estimated to be less than 10% of the total[1-2]. Chemical compounds in plants mediate their effect on the human body through processes identical to those already well understood for the chemical compounds in conventional drugs; thus herbal medicines do not differ greatly from conventional drugs in terms of how they work. This enables herbal medicines to be as effective as conventional medicines, but also gives them the same potential to cause harmful side effects[1-3].The use of plants as medicines predates written human history.

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Ethnobotany (the study of traditional human uses of plants) is recognized as an effective way to discover future medicines.In 2001, researchers identified 122 compounds used in modern medicine which were derived from "ethnomedical" plant sources; 80% of these have had an ethnomedical use identical or related to the current use of the active elements of the plant[2]. Many of the pharmaceuticals currently available to physicians have a long history of use as herbal remedies, including aspirin, digitalis, quinine, and opium[4].

The use of herbs to treat disease is almost universal among non-industrialized societies, and is often more affordable than purchasing expensive modern pharmaceuticals. The World Health Organization (WHO) estimates that 80 percent of the population of some Asian and African countries presently use herbal medicine for some aspect of primary health care. Studies in the United States and Europe have shown that their use is less common in clinical settings, but has become increasingly more in recent years as scientific evidence about the effectiveness of herbal medicine has become more widely available.

***Ocimum tenuiflorum***, also known as ***Ocimum sanctum***, ***holy basil***, or ***tulasi***, is an aromatic plant in

the family Lamiaceae which is native to the Indian subcontinent and widespread as a cultivated plant throughout the Southeast Asian tropics[5-6].

Leaves have petioles and are ovate, up to 5 cm long, usually slightly toothed. The flowers are purplish in elongate racemes in close whorls[6]. The two main morphotypes cultivated in India and Nepal is green-leaved (Sri or Lakshmi tulasi) and purple-leaved (Krishna tulasi)[7].

Tulasi is cultivated for religious and medicinal purposes, and for its essential oil. It is widely known across the Indian subcontinent as a medicinal plant and an herbal tea, commonly used in Ayurveda.

**Pharmacognistic Study** [8-10]

It is much branched small herb and 30 to 75 cm in height. All parts of Tulasi are used in medicine, especially fresh and dried leaves. Leaves are oblong, acute with entire or serrate margin, pubscent on both sides and minutely gland dotted.

The leaves are green in color with aromatic flavour and slightly pungent taste. Flowers are purplish in color in the form of racemes. Nutlets are subglobose, slightly compressed, pale brown or red in color. Seeds are reddish black and subglobose.

**Botanical Classification**

Kingdom : Planta
Divison : Magnoliaphyta
Class : Magnoliopsida
Order : Lamiales
Family : Lamiaceae
Genus : *Ocimum*
Species : Sanctum

**Other Names**

English name - holy basil/sacred basil
Hindi name - tulsi
Sanskrit name - tulasi
Gujarati name – tulsi

**Habitat**

*Ocimum sanctum* is native to India, Iran and now cultivatedin Egypt, France, Hungary, Italy, Morocco, USA. Basil is naturally found wild in the tropical and subtropical regions of the world. Basil thrives in warm and temperate climates. Basil is an aromatic, low growing herb the leaves of which have a bright green to purple ovate color, and is grown in warm, tropical climate.

**Therepeutic Uses**

Some of the basils are a rich source of key nutrients like Vitamin A, Vitamin C, calcium and phosphorus. The presence of Vitamin A helps in strengthening eyesight.

a. Basils also contain antioxidants like beta carotene that help in preventing cell damage.

b. “Tulsi” or the holy basil, is famous throughout the globe for its healing and other medicinal properties. Its leaves are helpful in sharpening memory and in curing fever and common cold.

c. They also act as an anti stress agent and also help in purifying blood. This, in turn, helps in reducing the risk of heart attacks and also lowers the cholesterol level.

d. The leaves of the basil are also effective in reducing mouth ulcer and other infections of the mouth.

**Cultivation**

a. Basil grows to between 30-130 cm tall, with opposite, light green, silky leaves 3-11 cm long and 1-6 cm broad. The flowers are small, white in color and are arranged in a terminal spike. Unusual among Laminacaea , the four stamens and the pistil are not pushed under the upper lip of corolla, but lie over the inferior lip. After entomophilous pollinatioin, the corolla falls off and four round achenes develop inside the bilabiate calyx.

b. Basil is very sensitive to cold, with best growth in hot, dry conditions. It behaves as an annual if there is any chance of a frost. Although basil will grow best outdoors, it can be grown indoor in a pot and, like most herbs, will do best on an equator-facing windowsill. It should be kept away from extremely cold drafts, and grows best in strong sunlight; therefore a greenhouse or row cover is ideal if available. They can, however, be grown even in a basement, under fluorescent lights.

**Uses**

- Used for bronchial asthma; expectorant and bronchodilator effects.
- Used against respiratory ailments including bronchititis and tuberculosis.
- Used for rhinitis (inflammation of nasal mucus membrane).
- Can serve as a cure and prophylactic as well for the severe acute respiratory syndrome (SARS) – The root of the tulsi plant should be crushed and boiled with turmeric powder for a few minutes, after which it should be filtered. Consuming two spoonfuls of this potion twice daily will cure SARS and prevent contracting of the disease.
- Tulsi tea with honey is a good expectorant especially in cased where fever is involved.

- The juice of the leaves is given in catarrh and bronchitis in children.
- Chewing the leaves relieves cold and flu. A decoction of the leaves, cloves and common salt also gives immediate relief in case of influenza.

**Active compounds in tulsi**

Tulsi leaves contain bright, yellow coloured and pleasant volatile oil (0.1 to 0.9%). The oil content of the drug varies depending upon the type, the place of cultivation and season of its collection. The oil is collected by steam distillation method from the leaves and flowering tops. It contains approximately 7.0% eugenol, carvacrol (3%) and eugenol-methyl ether (20%). It also contains caryophyllin, ursolic acid, rosmaric acid, thymol, methyl chavicol, citral, carvacrol, β-caryophyllene [11]. Seeds contain fixed oil with good drying properties.

The plant is also reported to contain alkaloids, glycosides, saponins, tannins, an appreciable amount of vitamin C, and traces of maleic acid, citric and tartaric acid.

**Eugenol**

Eugenol (1-hydroxy-2-methoxy-4-allylbenzene), which is the major constituent of the essential oil (steam distilled from fresh leaves of *Ocimum sanctum* L.), is responsible for the therapeutic potential of the essential oil and it is a phenolic compound [12, 13].

Several investigations in experimental animals have been carried out using the extracts of Tulsi leaves to establish the pharmacological actions of Eugenol, essential oils extracted from Tulsi leaves on central nervous system, reproductive system, immune system, gastric system, blood biochemistry etc [12, 14-22]. It has been observed that eugenol and the essential oils possessed membrane stabilizing properties on synaptosomes, erythrocytes and the mast cells which account for the therapeutic potentials of Tulsi in management of neurological, inflammatory and allergic disorders [12]. It was also found to reduce raised blood sugar, cholesterol and triglyceride levels and activities of GPT, GOT, LDH and alkaline phosphatase in blood serum and thereby it is therapeutically used as cardioprotective, antidiabetic, hepatoprotective and hypolipidemic agent. Eugenol was also reported to possess vasorelaxing action on rabbit arterial tissue indicating its therapeutic importance as a vasodilator [23]. The antiulcerogenic action of eugenol and essential oil extracted from Tulsi leaves helps in the treatment of gastric ulcer [12,19].

*Ocimum sanctum* is also used in immunological disorders associated with immunosuppression as eugenol and essential oils have been shown to be immunostimulant [12]. Lowering of uric acid level by extract of Tulsi leaves and eugenol claims the therapeutic potential of *Ocimum sanctum* in treatment of rheumatoid arthritis [12,20]. The essential oils extracted from Tulsi leaves also possessed antimicrobial properties like anti-fungal, anti-viral, anti-bacterial (inhibited in-vitro growth of E. coli, B.anthracis and P. aeruginosa), anti-tubercular ( inhibited in-vitro growth of M.tuberculosis) activities.

**Therapeutic Uses of Ocimum**

The following reported activities of *Ocimum sanctum* show that it is a potent herbal remedy for lot more disorders.

**1. Chemoprotective activity**

Protection against the development of the skin papillomas and chemically induced oral cancer in rodents has been shown by the *Ocimum sanctum* plant extractts [24].

The anticancer activity of OS has been proved and cited by several investigators [25-28]. The alcoholic extract (AlE) of leaves of OS has a modulatory influence on carcinogen metabolizing enzymes such as cytochrome P 450, cytochrome b5, aryl hydrocarbon hydroxylase and glutathione S-transferase (GST), which are important in detoxification of carcinogens and mutagens [29]. The anticancer activity of OS has been reported against human fibrosarcoma cells culture, wherein AlE of this drug induced cytotoxicity @ 50 µg/ml and above. Morphologically, the cells showed shrunken cytoplasm and condensed nuclei. The DNA was found to be fragmented on observation in agarose gel electrophoresis [30].

A similar activity was observed for eugenol, a flavonoid present in many plants, including Tulsi [31]. Oral treatment of fresh leaves paste of Tulsi may have the ability to prevent the early events of DMBA induced buccal pouch carcinogenesis [32]. Leaf extract of OS blocks or suppresses the events associated with chemical carcinogenesis by inhibiting metabolic activation of the carcinogen [33]. The anticancer activity of OS was observed in Swiss albino mice bearing Ehrlich ascites carcinoma (EAC) and S 180 tumours [34].

**2. Hypoglycemic activity**

Hypoglycemic and hypolipidemic effects has been shown in the diabetic rats when tulsi leaf powder was fed at 1% level in normal and diabetic rats for a period of one month [35].

**3. Anti-hyperlipidaemic activity**

*Ocimum sanctum* Seed oil has hypocholesterolaemic and antioxidant effects but it did not have any anti-diabetic effect as two weeks treatment of diabetic rabbits with *Ocimum sanctum* Seed oil shows no significant hypoglycemic effects [36].

**4. Anti-lipidperoxidative activity**

Aqueous extracts of *Ocimum sanctum* inhibited hypercholesterolemia-induced erythrocyte lipid peroxidation activity [37].

**5. Anti-oxidant activity**:

The antioxidant activity of *Ocimum Sanctum* has been reported by many workers [38-40]. The antioxidant properties of flavonoids and their relation to membrane protection have been observed [41]. Antioxidant activity of the flavonoids (orientin and vicenin) *in vivo* was expressed in a significant reduction in the radiation induced lipid peroxidation in mouse liver [42].

*Ocimum sanctum* extract has significant ability to scavenge highly reactive free radicals [43]. The phenolic compounds, viz., cirsilineol, cirsimaritin, isothymusin, apigenin and rosmarinic acid, and appreciable quantities of eugenol (a major component of the volatile oil) from OS extract of fresh leaves and stems possessed good antioxidant activity [44].

Administration of ethanolic extract of *Ocimum sanctum* attenuates the alterations induced by noise exposure [45].

**6. Anti-ulcer activity**:

The fixed oil of *Ocimum sanctum* was found to posses significant anti-ulcer activity against aspirin, indomethacin, alcohol, histamine, reserpine, serotonin and stress induced ulceration in experimental animal models [46].

**7. Cardiovascular activity**

Chronic oral administration of *Ocimum sanctum* augments cardiac endogenous antioxidants and prevents isoproterenol-induced myocardial necrosis in rats [47].

**8. Effect on nervous system**

*Ocimum sanctum* could be a probable herbal remedy for noise induced biogenic amine alterations [48, 49].

The AlE of OS prolonged the time of lost reflex in mice due to pentobarbital (40 mg/kg, ip), decreased the recovery time and severity of electroshock and pentylenetetrazole induced convulsions. It also decreased apomorphine induced fighting time and ambulation in "open field" trials. At high doses, OS extract increased swimming time suggesting a CNS stimulant and/or antistress activity. The effect was comparable to that of desipramine, an antidepressant drug **[50]**. OS fixed oil (2-3 ml/kg, ip) has been reported **[51]** to increase pentobarbitone-induced sleeping time in rats. The inhibition of hepatic metabolism of pentobarbitone / renal clearance by fixed oil could be responsible for potentiation of pentobarbitone-induced sleeping time.

**9. Effect on reproductive system**:

Feeding Tulsi leaves along with the normal diet in adult male Wistar rats decreased in sexual behavioral score **[52]**.

**10. Hepatoprotective activity**:

Hepatoprotective activity of *Ocimum sanctum* leaf extract against paracetamol induced hepatic damage in rats has been reported **[53]**.

Oral administration of hydroethanolic extract of OS leaves @ 200 mg/kg in male Wistar albino rats gave protection against liver injury induced by paracetamol. The cold water extract (3g/100g, orally for 6 days) of OS was found to be effective against carbon tetrachloride (0.2 ml/100 g, subcutaneously) induced liver damage in albino rats **[54]**.

**11. Hypotensive activity**:

*Ocimum sanctum* fixed oil produced hypotensive effect in anaesthetized dog, which seems to be due to its peripheral vasodilatory action. The oil increased blood-clotting time and percentage increase was comparable to aspirin and could be due to inhibitation of platelet aggregation **[55]**.

**12. Analgesic activity**:

Analgesic activity of the alcoholic extract of the leaves of *Ocimum sanctum* has been observed in both, glacial acetic acid-induced writhing and radiant heat-induced tail flick test [48]. Recent studies suggest that Tulsi may be a COX-2 inhibitor, like many modern pain killers, due to its high concentration of eugenol.

The OS oil was found to be devoid of analgesic activity in experimental pain models (tail flick, tail clip and tail immersion methods). However, it was effective against acetic acid induced writhing method in mice in a dose dependent manner. The writhing inhibiting activity of the oil is suggested to be peripherally mediated due to combined inhibitory effects of prostaglandins, histamine and acetylcholine [56].

**13. Anthelmintic activity**

The essential oil of *Ocimum sanctum* showed potent anthelmintic activity in the Caenorhabditis elegans model [57].

**14. Anti-amnesic and nootropic activity**

When compared to control, scopolamine and aged groups of mice, *Ocimum sanctum* whole plant extract decreased transfer latency and increased step down latency significantly [58].

**15. Anti-bacterial activity**

*Ocimum sanctum* fixed oil showed good antibacterial activity against Staphylococcus aureus, Bacillus pumilus and Pseudomonas aeruginosa [59].

Essential oils extracted from the leaves of *Ocimum sanctum* L. has been found to inhibit growth of E. coli, B.anthracis and P. aeruginosa in-vitro, showing its antibacterial activity. *Ocimum sanctum* also possesses antifungal activity against Asperigillus niger and aqueous extract of it was found to be effective in patients suffering from viral encephalitis [60].

**16. Anti-cataract activity**

Aqueous extract of *Ocimum sanctum* possess potential anti-cataract activity against selenite-induced experimental cataractogenesis [61].

The AqE of fresh leaves of OS delayed the process of cataractogenesis in experimental models of cataract (galactosemic cataract in rats by 30% galactose and naphthalene cataract in rabbits by 1 g/kg naphthalene). OS 1 and 2 g/kg delayed the onset as well as subsequent maturation of cataract significantly in both the models [62].

**17. Anti-fertility activity**

Treatment of albino rats with a benzene extract of *Ocimum sanctum* leaves for 48 days decreased total sperm count, sperm motility, and forward velocity [63]. The leaves of *Ocimum sanctum* were found to possess abortifacient effect in women [64-66]. *Ocimum sanctum* has also got antifertility effect [67, 68-71]. The benzene and petroleum ether extracts of leaves of Tulsi have been reported to produce 80% and 60% antifertility activity respectively in female rats [68,69]. In Kerala the local women as well as the Ayurvedic physicians have been reported to use the leaves of Tulsi for antifertility effect [68]. In male rats benzene extract of Tulsi leaves was found to reduce spermatogenesis by means of retarding the sertoli cell activity without affecting the germ cells [67].

The major constituent of the Tulsi leaves found to possess antifertility effect in rats of both sexes and in male mice was Ursolic acid .Ursolic acid because of its anti-estrogenic effect reduces spermatogenesis and causes a decrease in sperm counts.

**18. Anti-inflammatory activity**

The fixed oil of *Ocimum sanctum* (Labiatae) was found to posses significant anti-inflammatory activity against carrageenan -and different other mediator- induced paw edema in rats [72].

**19. Anti-stress activity**

An adaptogen is an agent that helps the body adapt more efficiently to stress. Adaptogen reduce the intensity and negative impact of stress caused by tension, emotional difficulties, poor life style habits, disease and infection, pollution and other factors. Tulsi is one of the most effective adaptogen known. The immunostimulant capacity of OS may be responsible for the adaptogenic action of plant [73]. The alcoholic extract of OS whole plant increased the physical endurance (survival time) of swimming mice, prevented stress induced ulcers and milk induced leucocytosis, respectively in rats and mice, indicating induction of non-specifically increased resistance against a variety of stress induced biological changes by OS in animals [74].

Hydroalcoholic extract of *Ocimum sanctum* protected the rats from chronic restraints stress induced changes in the myocardium [75]. The reduction in corticosterone level caused by chronic exposure to noise stress was prevented by the treatment of animals with *Ocimum sanctum* extract [76]. Ayurvedic tradition classifies tulsi as an adaptogenic herb, capable of increasing the body's resistance to stress and disease.

**20. Anti-thyroid activity**

The effects of *Ocimum sanctum* leaf extract on the changes in the concentrations of serum T3, T4 were investigated in the male mouse. *Ocimum sanctum* leaf exhibited anti-thyroidic and anti-oxidative properties [77].

**21. Anti-toxic effect**

Oral administration of *Ocimum sanctum* extract provided protection against HgCl2 induced toxicity in Swiss albino mice [78].

The median lethal dose (LD50) of OS fixed oil was determined after ip administration in mice. The fixed oil was well tolerated up to 30 ml/kg, while 100% mortality was recorded with a dose of 55 ml/kg. The LD50 of oil was 42.5 ml/kg. There was found no untoward effect on subacute toxicity study of OS fixed oil at a dose of 3 ml/ kg/day, ip for 14 days in rats [79].

**22. Anti-tussive activity**

Aqueous and methanolic extracts of *Ocimum sanctum* exhibited anti-tussive effect by central action probably mediated both opioid system & GABA-ergic system [80].

**23. Immunomodulatory activity**

*Ocimum sanctum* modulates the humoral immune responses by acting at various levels in the immune mechanisms such as antibody production, release of mediators of hypersensitivity reactions, and tissue responses to these mediators on the target organs [81].

Steam distilled extract from the fresh leaves of OS showed modification in the humoral immune response in albino rats which could be attributed to such mechanisms as antibody production, release of mediators of hypersensitivity reactions and tissues responses to these mediators in the target organs [82]. OS seed oil appears to modulate both humoral and cell-mediated immune responsiveness and GABAergic pathways may mediate these immunomodulatory effects [83].

**24. Lens aldose reductase inhibiting activity**

*Ocimum sanctum* offered maximum aldose reductase inhibiting activity followed by *Curcuma longa*, *Azadirachta indica* and *Withania somnifera* [84].

**25. Radioprotective activity**

The radioprotective effect of OS was firstly reported in the year 1995 [85]. Two isolated flavonoids, viz., orientin and vicenin from OS leaves showed better radioprotective effect as compared with synthetic radioprotectors. They have shown significant protection to the human lymphocytes against the clastogenic effect of radiation at low, non toxic concentrations [86]. The combination of OS leaf extract with WR-2721 (a synthetic radioprotector) resulting in higher bone marrow cell protection and reduction in the toxicity of WR-2721 at higher doses, suggested that the combination would have promising radioprotection in humans [87].

Aqueous extract of *Ocimum sanctum* used for ameliorating 131 Iodine-induced damage to the salivary glands [88].

**26. Wound-healing activity**

Aqueous extract of *Ocimum sanctum* Possessed significant wound healing and antioxidant activities, which may be useful in the management of abnormal healing such as keloids and hypertrophic scars [89].

**27. Ethnoveterinary activity**

The whole plant is used in treatment of glossitis, ulcers, maggots in wounds, anthrax, pneumonia, tympanitis, pain in abdomen, constipation, stoppage of urination, liver fuke, loss of appetite, stomach pain, dog bite, cold and cough, cannabis poisoning, opacity of cornea, swelling of lungs, tachycardia, sprains and sore eyes. The leaves are used in treatment of bleeding, cough and cold, eye diseases, udder infection and wound healing in ruminants [90].

*Ocimum sanctum* treatment significantly prevented hypoperfusion-induced functional and structural disturbances [91]. The leaf extract protected mice against haloperidol-induced catalepsy and protective effects are comparable with standard drugs, scopolamine and ondansetron [92]. It is also used as an Antidote for snake bites and scorpion stings.

**Conclusion**

Tulasi is a popular home remedy for many ailments such as wound, bronchitis, liver diseases, hiccough, ophthalmia, gastric disorders, genitourinary disorders, skin diseases, various forms of poisoning and psychosomatic stress disorders1-2. It has also aromatic, stomachic, carminative, demulcent, diaphoretic, diuretic, expectorant, alexiteric, vermifuge and febrifuge properties. Tulsi is also known as "the elixir of life" since it promotes longevity. Different parts of plant are used in Ayurveda and Siddha Systems of Medicine for prevention and cure of many illnesses and everyday ailments like common cold, headache, cough, flu, earache, fever, colic pain, sore throat, bronchitis, asthma, hepatic diseases, malaria, fever, as an antidote for snake bite and scorpion sting, flatulence, migraine headaches, fatigue, skin diseases, wound, insomnia, arthritis, digestive disorders, night blindness, diarrhea and influenza. A future aspect of tulsi uses is still untouched in the field of cosmetics as it can yield a better inflammation gel, sprays and ointments. This review will definitely help for the researchers as well as clinicians dealing with *Ocimum sanctum* to know its proper usage as this herb is seemed to be highly valuable, possessing many pharmacological/ medicinal properties.

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