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Therapeutic and Phytochemical Applications of *Ocimum Sanctum*

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ABSTRACT

The Ocimum sanctum plant, including its leaves, flowers, and occasionally the entire plant, is used medicinally in ayurveda to treat conditions like leucoderma, stranguria, asthma, bronchitis, lumbago, and ear discharge that is purulent. The leaf juice has expectorant, stimulant, diaphoretic, and antiperiodic effects. It is applied topically to treat ringworm and other skin conditions, and it is used to treat infantile cough, colds, bronchitis, diarrhoea, and dysentery. For youngsters with gastrointestinal issues, a leaf infusion is utilised as a stomachic. According to reports, the oil made from the leaves has insecticidal and antibacterial characteristics and works well as a mosquito repellent.

Keywords*: Ocimum Sanctum, Tulsi, Ayurvedic Properties, Eugenol.*

INTRODUCTION

In India, the herb Tulsi widely known for its health promoting and medicinal value for thousands of years. Commonly called sacred or holy basil, it is a principal herb of Ayurveda. So many beautiful nomenclatures are mentioned for this religious plant. Holy basil is also known as "The Incomparable One", "The Mother Medicine of Nature", and "The Queen of Herbs". The botanical name is *Ocimum sanctum*.

It is a well known aromatic plant in the family Lamiaceae. Tulsi is frequently mentioned as one of the main pillars of herbal medicine. The sacred plant is described as a protector of life, preventing misery and disease from birth through old age and death and even then aiding the passage to the heavens. The economically important part of *Ocimum sanctum* leaves and tender parts of the shoots). In ayurveda, the *Ocimum sanctum* leaves, flowers and occasionally the whole plant is used medicinally in the treatment of heart and blood diseases, leucoderma, strangury, asthma, bronchitis, lumbago and purulent discharge of the ear.

The leaf juice possesses diaphoretic, antiperiodic, stimulant and expectorant properties. It is used to treat infantile cough, cold, bronchitis, diarrhoea and dysentery and it is applied to the skin to treat ringworm and other skin diseases. An infusion of the leaves is used as a stomachic for gastric disorders in childrens. The oil extracted from the leaves is reported to possess antibacterial and insecticidal properties, and is effective as a mosquito repellent [1-4].

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History [5]

The Tulsi is believed to be Lakshmi's incarnation on earth. The Tulsi plant is known in India in two forms – One is the dark or Shyama (Krishna) Tulsi and light or Rama Tulsi. The former possesses greater medicinal value and is commonly used for worship. Tulsi, is worshiped throughout India, most often regarded as a consort of Vishnu in the form of Mahalakshmi. There are two types of Tulsi worshiped in Hinduism—"Rama Tulsi" has light green leaves and is larger in size; "Krishna Tulsi" has dark green leaves and is important for the worship of Vishnu and Narayana. Many Hindus have tulsi plants growing in front of or near their home, often in special Tulsi pots. It is also frequently grown next to Vishnu temples, especially in Varanasi [5].

SAMHITA PERIOD

The presence of a Tulsi plant symbolizes the religious bent of a Hindu family. In many traditions *(i.e* Vaishnavism), a household is considered incomplete if it doesn't have a Tulsi plant. Many families have the Tulsi planted in a specially built structure, which has images of deities installed on all four sides, and a niche for small earthen oil lamp. Some households can even have up to a dozen Tulsi plants on the verandah or in the garden forming a "Tulsi-van" or "Tulsivrindavan" — a miniature basil forest. Tulsi has been used for thousands of years in Ayurveda for its diverse healing properties. It is mentioned by Charaka in the Charaka Samhita, an ancient Ayurvedic text. Tulsi is considered to be an adaptogen, balancing different processes in the body, and helpful for adapting to stress. Marked by its strong aroma and astringent taste, it is regarded in Ayurveda as a kind of "elixir of life" and believed to promote longevity [6-7].

TAXONOMY [8]

Kingdom	:	Plantae
Division	:	Angiosperms
Order	:	Lamiales
Family	:	Lamiaceae
Genus	:	Ocimum
Species	:	*Ocimum sanctum*

VERNACULAR NAMES [9]

Sanskrit – Tulasi – Tulssi – Surasa – Krishnamul – Vishnu-priya; Hindi – Kala tulasi; English – Holy Basil; Unani – Tulsi; Bengali – Krishna tulasai; Tamil - Thulasi

Origin, Habitat and Distribution [10]

Its origin are India, Africa and Mediterranean Region. Basil was first put to cultivation in India. It is cultivated world over now, including Asia, Africa and Central and Southern America. Among different species of genus *Ocimum*, the species *sanctum* occupies wide range of habitats. Among Indian species, *Ocimum basilicum* and *Ocimum sanctum* have the widest distribution, which cover the entire Indian subcontinent.

Tulsi is native throughout the Old World tropics and widespread as a cultivated plant and an escaped weed. It is cultivated for religious and medicinal purposes, and for its essential oil. It is widely known across South Asia as a medicinal plant and an herbal tea, commonly used in Ayurveda, and has an important role within the Vaishnavite tradition of Hinduism, in which devotees perform worship involving Tulsi plants or leaves.

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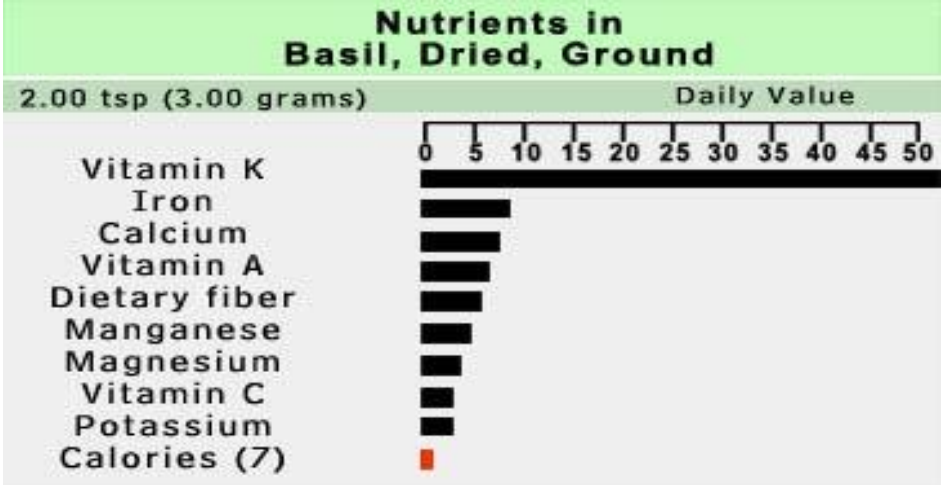
Botany

The genus *Ocimum* belongs to subfamily *Ocimoideae* of the family *Lamiaceae*. The plants of *Ocimum sanctum* are predominantly shrubs and herbs and are perennial in habit. The plants are usually much branched.

Stems and twigs are usually quadrangular. Young twigs are greenish, purplish or brownish in colour. The leaves are simple, petiolate and ovate. They possess glandular hairs or stalked and sessile glands which secrete volatile oils and they exhibit racemose type of inflorescence. Flowers are hermophordite, zygomorphic and complete. Seeds are mostly brownish, globose or subglobose and are shining or non-mucilaginous [11].

Nutritional Value of Basil [12]



AYURVEDIC PROPERTIES [13]

1. Rasa –Katu (sharp)
2. Tikta (bitter)
3. Virya –Ushna (hot)
4. Vipak -Katu (sharp)

Ayurvedic practice recommends Tulsi in several formulations to enhance immunity and metabolic functions as well as in the management of respiratory problems (Shwas -Kasa). In Ayurveda, Tulsi *(Ocimum sanctum L.)* has been well documented for its therapeutic potentials and described as Dashemani Shwasaharni (antiasthmatic) and antikaphic drugs (Kaphaghna). Although the traditional medical practitioners in India have been widely using this medicinal plant for management of various disease conditions from ancient time, not much is known about the mode of action of Tulsi, and a rational approach to this traditional medical practice with modern system of medicine is also not available. In last few decades, several studies have been carried out by Indian scientists and researchers to suggest the role of essential oils & eugenol in therapeutic potentials of *Ocimum sanctum L.*. Eugenol is a phenolic compound and major constituent of essential oils extracted from different parts of Tulsi plant. The therapeutic potential of Tulsi has been established on the basis of several pharmacological studies carried out with eugenol and steam distilled, petroleum ether and benzene extracts of different parts of Tulsi plant. The present article incorporates the names of some important plants of genus Ocimum, therapeutic uses of *Ocimum sanctum L.* and pharmacological actions & sources of eugenol. Among the plants known for medicinal value,

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the plants of genus Ocimum belonging to family Labiatae are very important for their therapeutic potentials. *Ocimum sanctum L.* (Tulsi), *Ocimum gratissium* (Ram Tulsi), *Ocimum canum* (Dulal Tulsi), *Ocimum basilicum* (Ban Tulsi), *Ocimum kilimandscharicum, Ocimum ammericanum, Ocimum camphora* and *Ocimum micranthum* are examples of known important species of genus Ocimum which grow in different parts of the world and are known to have medicinal properties [14-18].

PHYTOCHEMICAL PROPERTIES

Aroma Constituents - The major Aroma components are: 1,8 cineol, linalool, citral, eugenol, methyl chavicol (estragole), and methyl cinnamate [19].

Flavour Constituents - The chemical constituents that affect the flavour of Basil are monoterpenes (ocimene, geraniol, and camphor), sesquiterpenes (bisabolene, caryophyllene) and phenylpropanoids (methyl eugenol) selection. The aromatic compounds found in the essential oils of *Ocimum sanctum* are mainly the mono-terpenes, sesquiterpenes and phenols, alcohols, esters, aldehydes, ketones and others. A variety of biologically active compounds have been isolated from the leaves including ursolic acid, apigenin and luteolin [20].

MEDICINAL PROPERTIES

Overall, Tulsi is a premier adaptogen, helping the body and mind to adapt and cope with a wide range of physical, emotional, chemical and infectious stresses, and restore disturbed physiological and psychological functions to a normal healthy state.

This general vitality is enhancing and health promoting properties, in addition to Tulsi's many more specific therapeutic actions, likely account for much of the exceptionally broad range of Tulsi's traditional medical uses, as well as contributing to its mythological importance and religious sanctity [21].

1) **Holistic Health Promotion: -** Enhances general health and well-being, having positive overall effects on the body and mind.
2) **Stress Resilience: -** Increases the capacity to cope and adapt to changing and challenging environments, and reduces the negative physical and psychological effects of stress (adaptogenic).
3) **Energy and Performance Enhancement: -** Improves stamina and endurance, and increases the body's efficiency in using oxygen. Enhances protein synthesis and strength.
4) **Anti-Aging Effects: -** Slows the biological aging process by reducing the impact of physiological aging factors.
5) **Antioxidant Activity: -** Provides significant antioxidant and free radical scavenging protection. Neutralizes dangerous biochemical that contribute to premature aging, cataracts, cancer and other degenerative diseases.
6) **Radiation Protection: -** Reduces the cell and tissue damage caused by harmful rays of the sun, TV, computers, X-rays, radiation therapy, high altitude air travel, etc.
7) **Immunity Tune-Up:-** Strengthens and modulates the immune system. Reduces allergic histamine, asthmatic and other adverse immune reactions.
8) **Anti-inflammatory Action: -** Reduces the painful and dangerous inflammation that plays a key role in various forms of arthritis, cancer and degenerative neurological disorders.
9) **Antibiotic Protection: -** Offers significant natural antibacterial, antiviral and antifungal protection and is, thereby, helpful in treating many serious systemic diseases, as well as localized infections.

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10) **Heart and Vascular Protection: -** Lowers dangerous cholesterol and stress-related high blood pressure, protects the heart and blood vessels, and has mild blood thinning qualities, thereby decreasing the likelihood of strokes.
11) **Liver Support: -** Generally contributes to healthy liver function, improves the metabolic breakdown and elimination of dangerous chemicals in the blood, and counteracts various liver diseases.
12) **Lung and Bronchial Support: -** In addition to contributing generally to respiratory health, Tulsi has been shown to be helpful in the treatment of a variety of serious allergic, inflammatory and infectious disorders affecting the lungs and related tissues.
13) **Nutrition: -** Contains vitamins C and A, and minerals calcium, zinc and iron, as well as chlorophyll and many other phytonutrients. Also enhances the efficient digestion, absorption and use of nutrients from food and other herbs.
14) **Allopathic Medicine Complement: -** Enhances the effectiveness and reduces the negative and often dangerous side effects of many standard modern medical treatments.
15) **High Safety Margin: -** Research indicates that Tulsi has a very high safety margin with exceptionally low toxicity, providing general beneficial effects at doses without adverse reactions or other undesirable side effects.
16) A**ntimicrobial effects –** Essential oil of Tulsi have antibacterial, antifungal and antiviral properties. It inhibits the growth of E coli, *B.anthracis, M.tuberculosis* etc. It's antitubercular activity is one-tenth the potency of streptomycin and one-fourth that of isoniazid. Preparations containing Tulsi extract significantly shorten the course of illness, clinical symptoms and the biochemical parameters in patients with viral hepatitis and viral encephalitis.
17) **Antimalarial effects –** Essential oil of Tulsi has been reported to possess 100% larvicidal activity against the Culex mosquitoes. Trials have shown excellent antimalarial activity of Tulsi. It's extracts have marked insecticidal activity against mosquitoes.It's repellant action lasts for about two hours
18) **Antiallergic and Immunomodulator effects -** Essential oil of Tulsi was found to have anti-allergic properties. When administered to laboratory animals, the compound was found to inhibit mast cell degranulation and histamine release in the presence of allergen. These studies reveal the potential role of *Ocimum sanctum* extracts in the management of immunological disorders including allergies and asthma.
19) **Antistress/Adaptogenic effects -** Extracts from the plant have been found to reduce stress.
20) **Antifertility effect –** One of the major constituents of the leaves, ursolic acid has been reported to possess antifertility activity in rats and mice, This effect has been attributed to its antiestrogenic effect which may be responsible for arrest of spermatogenesis in males and inhibitory effect on implantation of ovum in females. This constituent may prove to be a promising antifertility agent devoid of side effects.
21) **Anti diabetic effect -** A randomized, placebo-controlled cross-over single blind trial on 40 human volunteers suffering from Type II diabetes was performed. During the four week trial, subjects alternately received a daily dose of 2.5 g of Tulsi leaves powder or a placebo for two week periods. The results showed 17.6 % reduction in fasting blood glucose and 7.3% decline in postprandial blood glucose on treatment with Tulsi as compared to the blood glucose levels during treatment with placebo
22) **For Heart ailments -** As 'Tulsi' (basil) has a positive effect over blood pressure and also a detoxicant, its regular use prevents heart attacks. A tonic may be prepared by mixing 1 gm of dry 'Tulsi' leaves with a spoonful of butter and some candy sugar or honey. Take

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twice a day; first thing in the morning and before going to bed at night. The drinking of Tulsi-leaf tea keeps the blood pressure even

23) **Other Benefits: -** Lowers fever, protects against gastric ulcers, reduces dangerous blood sugar levels in diabetics, and supports dental and periodontal health (and diminishes "bad breath"). Also protects against mercury poisoning, speeds healing of bone fractures, reduces nausea, vomiting and cramping, and repels insects, including mosquitoes and lice.

THERAPEUTIC PROPERTIES

Several medicinal properties have been attributed to *Ocimum sanctum* L. [16–27.] Different parts of Tulsi plant e.g. leaves, flowers, stem, root, seeds etc. are known to possess therapeutic potentials and have been used, by traditional medical practitioners, as expectorant, analgesic, anticancer, antiasthmatic, antiemetic, diaphoretic, antidiabetic, antifertility, hepatoprotective, hypotensive, hypolipidmic and antistress agents. Tulsi has also been used in treatment of fever, bronchitis, arthritis, convulsions etc [22].

Aqueous decoction of Tulsi leaves is given to patients suffering from gastric and hepatic disorders [12, 14]. Herbal preparations containing *Ocimum sanctum L.* have been suggested to shorten the course of illness, clinical symptoms and biochemical parameters in patients suffering from viral hepatitis [12]. The leaf juice of *Ocimum sanctum L.* along with Triphala is used in Ayurvedic eye drop preparations recommended for glucoma, cataract, chronic conjunctivitis and other painful eye diseases. The juice of fresh leaves is also given to patients to treat chronic fever, dysentery, hemorrhage and dyspepsia (12, 14). A decoction of Tulsi leaves is a popular remedy for cold (12, 14). Tulsi leaves also check vomiting and has been as anthelmintic (4). As a prophylactic against malaria, fresh

Tulsi leaves are taken with black pepper in the morning (14). Ayurvedic preparation containing *Ocimum sanctum L., Allium stivum, Piper nigram* and *Curcuma longa* has been shown to possess antimalarial activity against *Plasmodium vivex* and *Plasmodium falciparum.* This preparation has been found to relieve the clinical symptoms in 52% of *Plasmodium vivex* patients and 100% *of Plasmodium falciparum* patients. A decoction of the root of Tulsi plant is given as a diaphoretic in malarial fever. As far as its antimalarial effect is concerned Tulsi extracts and essential oil have also been found to possess insecticidal and larvicidal activities against mosquitoes. Aqueous extract of Tulsi is found effective in patients suffering from viral encephalitis [23].

Aqueous decoction of whole plant lowers the blood sugar (glucose) level and is said to control diabetes mellitus. Paste of Tulsi leaves are found effective in the treatment of ring-worm and other skin diseases. Tulsi has been also recommended for use as antidote for dog bite, scorpion bite and insect bite in traditional system of medicine. The fresh leaves and flower tops *of Ocimum sanctum L.* have been used as antispasmodic agent (as smooth muscle relaxant). The seeds are mucilaginous and demulcent and are given in disorders of the genitourinary system. The leaves of Tulsi plant have also been shown to possess good anti-stress (adaptogenic), analgesic, anti-hyperlipidemic, antioxidant potentials in experimental animals. Leaves and seeds of Tulsi plants have been reported to reduce blood and urinary uric acid level in albino rabbits and possess diuretic property. Gastric ulceration and secretion are reported to be inhibited by Tulsi in albino rats [25].

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The leaves of *Ocimum sanctum L.* are said to have abortifacient effect in women. *Ocimum sanctum L.* has also got antifertility effect [16–20]. The seeds of *Ocimum ammericanum* have been found to possess antifertility activity in women when given along with *Actinopteris radiate [26].*

Pharmacological Studies

In traditional Ayurvedic system of medicine, several medicinal properties have been attributed to this plant. Recent pharmacological studies have established the anabolic, hypoglycemic, smooth muscle relaxant, cardiac depressant, antifertility, adaptogenic and immunomodulator properties of this plant

Several studies have shown that steam distilled essential oils extracted from fresh leaves of *Ocimum sanctum L.* have therapeutic importance. The therapeutic potential of the essential oils extracted from fresh leaves of *Ocimum sanctum L.* has been found to be largely due to eugenol (major constituent of the essential oil) which is a phenolic compound (l-hydroxy-2-methoxy-4- allylbenzene). In order to understand the mode of action of *Ocimum sanctum L.*, to explain its therapeutic potentials in management of various disease conditions and to establish its use in modern medicine, several investigations have been carried out to study the pharmacological actions of the eugenol, essential oils (extracted from Tulsi leaves) & extracts of Tulsi on immune system, central nervous system, gastric system, reproductive system, blood biochemistry etc. in experimental animals [27].

Eugenol and the essential oils have been found to reduce raised blood sugar, triglyceride & cholesterol levels and activities of LDH, GPT, GOT and alkaline phosphatase (diagnostic clinical enzymes) in blood serum explaining the therapeutic potentials of *Ocimum sanctum L.* as antidiabetic, cardio protective, hypolipidemic and hepatoprotective agent. Eugenol has been well shown to possess the vasorelaxing action on rabbit arterial tissue indicating its therapeutic importance as a vasodilator [28].

Eugenol and the essential oils have also been observed to possess membrane stabilizing properties on synaptosomes, erythrocytes and mast cells which account for the therapeutic potentials of Tulsi in management of neurological (e.g. convulsions & epilepsy), inflammatory and allergic disorders. The therapeutic use of *Ocimum sanctum L.* in treatment of gastric ulcer has been attributed to antiulcerogenic action of eugenol and essential oil extracted from Tulsi leaves. Lowering of uric acid level by extract of Tulsi leaves and eugenol claims the therapeutic potential of *Ocimum sanctum L.* in treatment of rheumatoid arthritis. Eugenol and the essential oils have also been shown to be immunostimulant claiming the therapeutic potential *of Ocimum sanctum L.* in immunological disorders associated with immunosuppression. Essential oils extracted from the leaves of *Ocimum sanctum L.* has been found to inhibit in-vitro growth of *E. coli, B. anthracis* and *P. aeruginosa* showing its antibacterial activity. Tulsi also has anti-tubercular activity and inhibits in-vitro growth of M *tuberculosis*. The essential oils extracted from Tulsi leaves also possess anti-fungal and anti-viral activity[28].

Plant Sources of Eugenol

Ocimum sanctum L. (Tulsi) and *Ocimum basilicum* (Ban Tulsi) are cheaper sources for commercial extraction of eugeno. The aerial parts (leaves, flowers & stem) of these plants contain essential oils with good percentage of eugenol. The leaves of *Ocimum sanctum L.* are chief source of essential oils followed by the inflorescence and stem, however, flowers

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contain more essential oils than leaves in *Ocimum basilicum.* The roots and fruits of these plants are almost completely devoid of any essential oil. The essential oil extracted from the Tulsi leaves by steam distillation largely contains eugenol. The other important constituents of the essential oil are carvacrol, methyl eugenol, caryophyllene etc. Quantitative variations have been seen in the composition of essential oils of *Ocimum sanctum L.* growing in different parts of India. The percent of eugenol in essential oil of *Ocimum sanctum L.* varies from 40% (in Jammu) to 71% (in Assam) [30]. Seasonal variation has also been observed in composition of essential oil extracted from Tulsi leaves. In month of November, *Ocimum sanctum L.* has been found to yield maximum amount of eugenol.

To produce eugenol-rich Ocimum variety, scientists of Regional Research Laboratory (RRL), Jammu, have developed a hybrid strain of *Ocimum gratissimum L.* using recurrent selection (FCA) technique of breeding and named it as "Clocimum". This "Clocimum" variety contains 60–65% eugenol and has been released by RRL to private partites for commercial multiplication on the field for production of eugenol. In RRL, Jammu, another heterotic F1 strain of Ocimum has been developed and named as "Clocimum-3c". This is an improved Eugenol-rich Ocimum variety containing 90–95% eugenol. This variety has also been released to the private and commercial farmers under the trade name RRL-og-1 [30].

Basil and Health Protection

The constituents found in basil are used for various medical purposes:

1) Flavonoids that is one of the important nutrient component found in basil provide protection at the cellular level. Orientin and vicenin are two water-soluble flavonoids gives positive effects on human white blood cells.
2) Volatile oils, which contain estragole, linalool, cineole, eugenol, sabinene, myrcene, and limonene protect against unwanted growth of Bacteria.
3) The eugenol component acts as anti inflammatory.
4) Basil is also a good source of magnesium due to which it prompts muscles and blood vessels to relax, this helps in promoting cardiovascular health.

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