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Review Paper

Tulsi: The Queen of Herbs and a Multifunctional Herbal Medicine

Pratiksha Lohot, Sneha Kumawat, Prajwal Kapse, Shivram Kedar, Vilasani Pandav*

Krishnarao Bhegade Institute of Pharamaceutical Education And Research,Talegaon Dabhade, Pune-410507,Maharastra,India.

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ABSTRACT

Ocimum sanctum L. (commonly known as Tulsi) is widely recognized in Ayurvedic medicine as a highly valuable medicinal plant with an exceptional range of pharmacological properties. It is particularly regarded as an adaptogen, meaning it helps the body maintain balance and resilience in response to various physical, chemical, and emotional stressors. The present review draws upon extensive scientific literature to highlight the protective as well as regulatory effects of Tulsi across multiple physiological systems.A major focus of the discussion is its influence on the central nervous system. Evidence suggests that Tulsi exhibits strong neuroprotective properties and supports cognitive function, indicating its potential role as a nootropic agent. In addition, it has been shown to possess anxiolytic and anti-stress effects, which may make it beneficial in managing mood disorders as well as in reducing the risk or progression of neurodegenerative conditions.Beyond its neurological effects, Tulsi also plays a significant role in overall systemic health. In the context of metabolic disorders, it has demonstrated notable anti-diabetic properties, helping regulate blood glucose levels. At the same time, its hepatoprotective action contributes to safeguarding the liver from chemical-induced damage, thereby supporting healthy liver function. When considering cardiovascular health, various studies have reported its ability to lower lipid levels, reduce blood pressure, and provide protective effects to the heart, highlighting its potential in managing cardiovascular diseases.The review also emphasizes the immunomodulatory capacity of Tulsi. It has been found to enhance both cellular and humoral immune responses, thereby strengthening the body's defense mechanisms against infections and diseases. A key factor underlying many of these therapeutic benefits is its potent antioxidant activity. By neutralizing free radicals and reducing oxidative stress—an important contributor to many chronic illnesses—Tulsi helps in maintaining cellular integrity and overall health.

***Corresponding Author:** Vilasani Pandav

Address: *Krishnarao Bhegade Institute of Pharamaceutical Education And Research,Talegaon Dabhade, Pune-410507,Maharastra,India..*

Email ✉: vilasinipandav773@gmail.com

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INTRODUCTION

Tulsi (*Ocimum sanctum* L.), referred to as Tulasi in Sanskrit and commonly known as holy basil in English, is a well-known culinary as well as medicinal herb that belongs to the Lamiaceae family. Indigenous to the Indian subcontinent, it has held a prominent place in Ayurvedic practices for over 3000 years due to its wide-ranging therapeutic applications. Traditionally, Tulsi is categorized into two main varieties: Krishna Tulsi (black variety) and Ram Tulsi (green variety), both of which are valued for their medicinal properties. Phytochemical investigations have identified several bioactive compounds present in Tulsi, including essential oils such as eugenol, along with other important constituents like thymol and ursolic acid. These compounds contribute significantly to its therapeutic potential. The plant is considered highly beneficial for human health owing to its diverse restorative effects, which is why its leaves are extensively incorporated into Ayurvedic formulations and traditional remedies.

Scientific and traditional evidence suggests that Tulsi may play a role in promoting longevity. Extracts derived from different parts of the plant are commonly utilized in managing a variety of health conditions, including common cold, inflammation, digestive disturbances, migraines, cardiovascular disorders, kidney stones, and other systemic ailments. In addition to its medicinal uses, Tulsi is also recognized for its environmental benefits, particularly its role in purifying and detoxifying the surrounding atmosphere.

The plant is rich in phytochemicals, which serve as an abundant source of secondary metabolites. These compounds exhibit considerable chemical and taxonomic diversity, although the exact mechanisms of many of them are still not fully understood. Nevertheless, numerous phytochemicals derived from Tulsi have found applications not only in human healthcare but also in agriculture, veterinary medicine, and scientific research. Furthermore, studies have demonstrated that these compounds possess significant antimicrobial properties, showing inhibitory effects against a wide range of microorganisms under in vitro conditions.[1,5]

Diseases of modern life

Although advancements in science and industrialization have significantly improved human life, modern living is increasingly associated with high levels of stress. The widespread use of digital technologies, particularly mobile devices and the internet, has accelerated the pace of daily life to such an extent that many individuals feel overwhelmed by the constant influx of information. At the same time, the rise of industrial agriculture has contributed to greater exposure to processed and packaged foods, along with harmful substances such as pesticides, synthetic packaging materials, and other industrial toxins.

In urban environments, these challenges are further compounded by factors such as widening economic disparities, social isolation, persistent noise, and various forms of environmental pollution affecting air, water, and soil. Additionally, there is a growing disconnection from natural surroundings, which has further impacted overall well-being. While industrial progress has undoubtedly contributed to increased life expectancy and population growth, it is now widely acknowledged that a significant proportion of global morbidity and mortality is linked to preventable, lifestyle-associated chronic diseases.

Currently, the world is facing a surge in conditions such as obesity, diabetes, cancer, neurodegenerative disorders, depression, and other chronic illnesses. These health issues are largely driven by modern lifestyle patterns, including physical inactivity, excessive consumption of sugar, unhealthy fats, salt, alcohol, and tobacco, as well as continuous exposure to a

wide range of environmental chemicals. Given this context, it is increasingly evident that effective strategies to address this global health burden lie not only within healthcare systems but also in individual lifestyle choices and daily habits. Consequently, meaningful improvements in public health are more likely to arise from changes in personal behavior and home environments rather than relying solely on medical interventions or pharmaceutical treatments.[6,12]

➢ PHARMACOLOGICAL ACTIONS AND USES

Figure 1:Tulsi Plant

Figure 2: Tulsi Powder

A wide range of scientific investigations have demonstrated the pharmacological activities of extracts obtained from different parts of the Tulsi (*Ocimum sanctum*) plant. These studies have examined preparations such as steam-distilled extracts as well as those derived using solvents like petroleum ether and benzene, along with its key bioactive constituent, eugenol. Findings indicate that these extracts exert significant effects across multiple physiological systems, including the immune, reproductive, central nervous, cardiovascular, gastrointestinal, urinary systems, and hematological functions.

Tulsi is commonly regarded as a rejuvenating or vitalizing herb, with evidence suggesting that it can enhance physical stamina and overall endurance. In traditional practice, it is consumed and applied in a variety of forms depending on the intended therapeutic use. These include fresh or dried leaves prepared as herbal teas (either hot or cold infusions), powdered leaf formulations, alcohol-based tinctures, and preparations in oil or ghee. Additionally, different parts of the plant such as seeds, roots, and stems are utilized in both internal (systemic) and external (topical) applications.

Beyond whole plant extracts, isolated compounds—particularly eugenol—have also been studied independently. In both human clinical trials and experimental animal studies, such purified constituents have been administered, in some cases via injection, to further evaluate their specific pharmacological effects and therapeutic potential.[1,2]

Stress resilience :

Experimental studies conducted on animal models such as mice and rats have indicated that *Ocimum sanctum* (Tulsi) exhibits notable adaptogenic properties. Findings from multiple investigations suggest that the plant enhances the body's ability to cope with stress and adapt to challenging or adverse conditions. These effects highlight its role in improving physiological resilience and providing a protective response against various stressors.

Tulsi leaves, in particular, are believed to support the body's natural capacity to maintain balance

under stress. Regular consumption has traditionally been recommended as a simple preventive measure; for instance, even healthy individuals may chew a small number of fresh basil leaves daily as part of a routine to help manage and reduce stress levels.[,12]

Common cold and fever :

Traditional practices and some scientific observations suggest that tender leaves of *Ocimum sanctum* (Tulsi), when boiled along with tea, may serve as a preventive remedy during seasons when mosquito-borne illnesses such as malaria and dengue are more prevalent. In Ayurvedic formulations, Tulsi is often combined with other medicinal plants such as *Piper nigrum* (black pepper) and *Curcuma longa* (turmeric). Such combinations have been reported to exhibit antimalarial activity, particularly against *Plasmodium vivax* and *Plasmodium falciparum*, and may help alleviate the clinical symptoms associated with these infections.

Additionally, a decoction prepared from the roots of the Tulsi plant has traditionally been used as a diaphoretic, promoting sweating during malarial fever, which is believed to assist in symptom relief. Beyond its role in febrile conditions, Tulsi is also a key ingredient in many Ayurvedic cough syrups and expectorant formulations. It is known to facilitate the clearance of mucus from the respiratory tract, making it beneficial in conditions such as bronchitis and asthma. Furthermore, chewing fresh Tulsi leaves is commonly practiced as a simple remedy to help reduce symptoms associated with the common cold and influenza-like illnesses.[8]

Antibiotic property :

Studies have shown that essential oils derived from the leaves of *Ocimum sanctum* (Tulsi) exhibit significant antimicrobial properties. In vitro investigations have demonstrated their ability to inhibit the growth of various pathogenic bacteria, including *Escherichia coli*, *Bacillus anthracis*, and *Pseudomonas aeruginosa*, indicating strong antibacterial activity. In addition to this, Tulsi has also been reported to possess antifungal effects, particularly against *Aspergillus niger*.

Further evidence suggests that aqueous extracts of *Ocimum sanctum* may have therapeutic potential in certain viral conditions, with some studies noting beneficial effects in patients with viral encephalitis. Traditionally, Tulsi has also been used in topical applications; for example, a paste made from its leaves is commonly applied in the treatment of ringworm infections and has been found to be effective in managing such fungal skin conditions.

Overall, Tulsi is recognized for its broad-spectrum antimicrobial properties, including antibacterial, antiviral, and antifungal activities. These characteristics contribute to its usefulness in managing a range of systemic diseases as well as localized infections, reinforcing its importance in both traditional and complementary medicine.[3,4]

Hypoglycemic, Hypolipidemic and Antioxidant properties :

Experimental studies using diabetic animal models have provided evidence for the metabolic benefits of *Ocimum sanctum* (Tulsi). In one such investigation, an aqueous extract of Tulsi was administered along with the diet to streptozotocin-induced diabetic rats over a period of eight weeks. The results demonstrated a significant reduction in fasting blood glucose levels, along with improvements in serum lipid profiles and glucose tolerance. Additionally, there was a marked decrease in lipid peroxidation products, indicating reduced oxidative damage.

The study further reported that Tulsi extract lowered the formation of lipid peroxidation markers such as thiobarbituric acid reactive

substances (TBARS), while simultaneously enhancing the activity of key antioxidant enzymes. These included superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), and glutathione transferases (GT). Moreover, levels of important endogenous antioxidants, particularly reduced glutathione (GSH), were found to be elevated in plasma as well as in vital organs such as the liver, lungs, kidneys, and brain.

Taken together, these findings suggest that Tulsi possesses considerable therapeutic potential, particularly in the management of diabetes. Its observed effects, including antihyperglycemic, hypolipidemic, and antioxidant activities, support its role as a beneficial natural agent in mitigating metabolic disorders and associated oxidative stress.[6,7]

Hepatoprotective, Renoprotective and Neuroprotective activities:

Leaf extract of *Ocimum sanctum* (Tulsi) showed hepatoprotective activity against paracetamol-induced toxicity by reducing serum enzymes like AST, ALT and ALP in rats, along with decreased fatty degeneration in liver tissue on histological study. Combined use of aqueous Tulsi extract with gentamicin prevented increase in serum creatinine and blood urea compared to gentamicin-only treated rats. Leaves and seeds of Tulsi were reported to lower blood and urinary uric acid levels in albino rabbits and also showed diuretic effects. Tulsi extract was found to prevent stress-induced dendritic loss in hippocampal neurons in rats. Studies indicate Tulsi has high safety margin and low toxicity, producing beneficial effects at low doses without adverse reactions. In Ayurveda, Tulsi is used alone or with other herbs for treating eye disorders like glaucoma, cataract and conjunctivitis, as well as conditions like catalepsy and bites from snakes and scorpions.[8]

Ayurveda and lifestyle medicine

As a traditional system of medicine and one of the world's oldest healing sciences, Ayurveda adopts a holistic philosophy toward health and disease, emphasizing the maintenance and promotion of well-being as well as the prevention of illness through balanced lifestyle practices. These practices involve the intake of fresh, minimally processed foods, the application of Rasayana formulations aimed at delaying ageing and preventing disease, structured detoxification procedures, and the regular use of adaptogenic herbs that support the body's ability to sustain equilibrium under diverse stress conditions.

The Ayurvedic use of medicinal and culinary plants is deeply rooted in India's rich biodiversity, offering a diversity of herbal resources that is unmatched by most other medical systems. Among the wide range of herbs employed in this tradition, none holds a status as significant as Tulsi, or holy basil (*Ocimum sanctum*), which is regarded with exceptional reverence for its therapeutic and spiritual importance.[9]

Uses of Tulsi

Tulsi In Ayurvedic Medicine:

Tulsi is an abundant source of essential oils and antioxidants that are tremendously effective in reducing stress on the human body. Tulsi is a potent medicinal herb that can reduce mental stress. Not only Hindus or Indians, but now the other people are also using Tulsi by recognising its immense therapeutic properties. It balances different processes in the body and is of great help in stress management. In the Indian Ayurveda system, the extracts of Tulsi are used as traditional medicine. Ayurvedic remedies for common colds, headaches, stomach disorders, inflammation, infections, heart disease, poisoning, cataracts, and malaria use the Tulsi. The Tulsi acts on the nervous system and strengthens it. It supports the heart. It serves as an appetiser and promotes digestion too. It facilitates the secretion of

digestive enzymes and prevents flatulence. Having detoxifying properties, the Tulsi purifies the blood of any toxins present in it. It has also been proved to be effective in reducing cholesterol levels. Antbacterial and anti-parasitic properties make it suitable for combating infectious diseases of various types. Recent findings have indicated that the Tulsi may well protect from radiation poisoning. It has also been shown that Tulsi possesses anticancerous properties. There has come up a belief that a Tulsi leaf swallowed daily will ensure protection from cancer. Apart from its religious significance, it is of great medicinal importance and is a prime herb in Ayurvedic treatment. The plant's extracts can be used to prevent and cure many illnesses and common ailments like the common cold, headaches, stomach disorders, inflammation, heart disease, various forms of poisoning and malaria. The essential oil extracted from Karpoora Tulsi is mainly used for medicinal purposes though used in the manufacture of herbal toiletry. The Plant Cultures project of the Medicines and Healthcare Products Regulatory Agency (MHRA) of the United Kingdom notes that the Tulsi plant in Ayurvedic medicine has been used topically for skin conditions like eczema and ringworm, and insect bites. It is also commonly used to reduce fevers, improve lung and digestion issues, reduce the effects of colds, and eliminate toxins/poisons. Tulsi is very effective in lowering blood sugar levels and controlling diabetes. Tulsi acts as a preventative antibacterial agent.5 In Ayurveda, Tulsi has been used for thousands of years for its various healing properties, as mentioned in a Hindu form of medical science. Charaka Samhita is an ancient Ayurvedic text consisting of the information of Tulsi. Tulsi is considered an Indian adaptogen, which balances the different processes in the body and helps adapt the stress. Tulsi is regarded in Ayurveda as a kind of "elixir of life" and is believed to promote longevity due to its strong aroma and astringent taste. Tulsi leaves prevent bacterial growth during the eclipses if it is sprinkled over the food in the stored water.[5]

Tulsi In Modern Medicine:

The research on modern medicine indicates that Tulsi might have been an effective treatment for conditions like ulcers, high cholesterol, Type-2 diabetes, obesity, and compromised/ suppressed immune systems (from diseases like cancers and AIDS). Plant cultures say the traditional uses of Tulsi in Ayurveda might be due to some intrinsic properties in many varieties of Tulsi, such as the essential oils containing an antiinflammatory compound called eugenol, and various acids with antioxidant and anti-inflammatory properties that could support the claims of Tulsi being a treatment for so many conditions, according to Ayurveda.[9]

Natural Medicine Uses:

Sidha, Unani and Ayurvedic medicine use Tulsi to treat various skin conditions, fevers, coughs, and internal ailments. Ayurvedic medicine treats bronchitis with a liquid tonic made from Tulsi leaves, which Indians mix with cardamom or lemon juice. All three medicinal systems date to ancient times and are based on natural remedies and treatments, primarily on herbs and plants.[10]

Tulsi In Your Home:

Like most herbs, the Tulsi plant is a delicious way to enhance the flavour of your cooking or make an excellent tea. The holy herb is very easy to grow, it is not harmful to animals, and this shrub looks very attractive as a decorative plant. The Tulsi plant is a greater addition to your household, either in your daily using spice or in your garden.[11]

Figure 3: Tulsi Tea

1. As Antidiabetic:

For a month, rats with and without diabetes were given 1% tulsi leaf powder to investigate its effects on serum and tissue lipid profiles, uronic acid, total amino acids, and fasting blood sugar. The fasting blood sugar, uronic acid, total amino acids, total cholesterol, triglycerides, phospholipids, and total lipids were all significantly reduced, according to the data. There was a considerable reduction in total lipids, triglycerides, and cholesterol in the liver. Kidney total lipids were considerably lower. There was a notable decrease in total cholesterol and phospholipids in the heart. These findings all point to Tulsi's hypoglycemic and hypolipidemic effects in diabetic rats.

Throughout history, medicinal plants have been utilized globally to cure a wide range of illnesses. About 150 species of fragrant plants, mostly found in tropical and subtropical regions of the world, belong to the genus Ocimum (Family: Labiatae). Numerous species in this genus are thought to have great therapeutic properties and are widely used in the traditional medical systems of many Asian, African, and South American nations. Holy basil, or tulsi (Ocimum sanctum), is an upright, hairy annual herb that grows in gardens and temples throughout India and the Himalayas, up to a height of 1,800 meters. Essential oil content is high in O. sanctum. Eugenol (70%) was found in the essential oil by gas-liquid chromatography. [12]

2. Antioxidant:

Hypoxanthine xanthine oxidase and OPPH assays based on high-performance liquid chromatography (HPLC) were used to assess the antioxidant capacity of essential oils produced by steam hydrodistillation from O. sanctumL. O. sanctum L. demonstrated a considerable antioxidant ability in the hypoxanthine xanthine oxidase experiment (IC50 = 0.46 µL/ml).

In a different investigation, the O. sanctum L. aqueous extract dramatically boosts the activity of antioxidant enzymes like superoxide dismutase and catalase levels in the extract-treated group relative to the control.

In male albino rabbits, O. sanctum L. aqueous extract inhibits the hypercholesterolemia-induced erythrocyte lipid peroxidation activity in a dose-dependent way. Significant protection against peroxidative damage caused by hypercholestrolemia is also given to aorta and leaver tissue through oral feeding.

Yanpallewaret al. investigated the impact of a methanolic extract of O. sanctum L. leaves on long-term hypoperfusion and cerebral reperfusion injury. The pretreatment of Osmum sanctum L. (200 mg/ kg/day for 7 days) inhibited the increase

in superoxide dismutase and lipid peroxidation that was brought on by reperfusion. During reperfusion, the pretreatment with Osimum sanctum L. also stabilized the tissue total sulfhydryl group levels. [12]

3. In Gastric Ulcer Treatment:

The antiulcerogenic properties of eugenol and essential oil derived from Tulsi leaves have been linked to the medicinal usage of Ocimum sanctum L. in the treatment of gastric ulcers.

In experimental animal models, it was discovered that the fixed oil of Ocimum sanctum L. (Labiatae) had strong antiulcer efficacy against ulceration caused by aspirin, indomethacin, alcohol, histamine, reserpine, serotonin, and stress. In rats with pylorus ligation, there was also a notable reduction in gastric output and aspirin-induced stomach ulcers. The oil's antiulcer action may have been aided by its histamine antagonistic, lipoxygenase inhibitory, and antisecretory properties. It is possible to classify O. sanctum fixed oil as a natural medicine with anti-inflammatory and antiulcer properties. [12]

4. Cardiac Activity:

Male Wister rats exposed to chronic-resistant stress (6 hours per day for 21 days) were given an oral dose of 100 mg/kg of O. sanctum L. hydroalcoholic extract. This prevented the myocardium's light microscopic alterations, the chronic-resistant stress-induced rise in plasma cAMP level, and myocardial superoxide dismutase and catalase activities.

Superoxide dismutase, glutathione peroxidase, and reduced glutathione in the heart are not altered by isoproterenol in wester rats fed fresh leaf homogenate of O. sanctum L. (50 and 100 mg/kg body weight) every day for 30 days

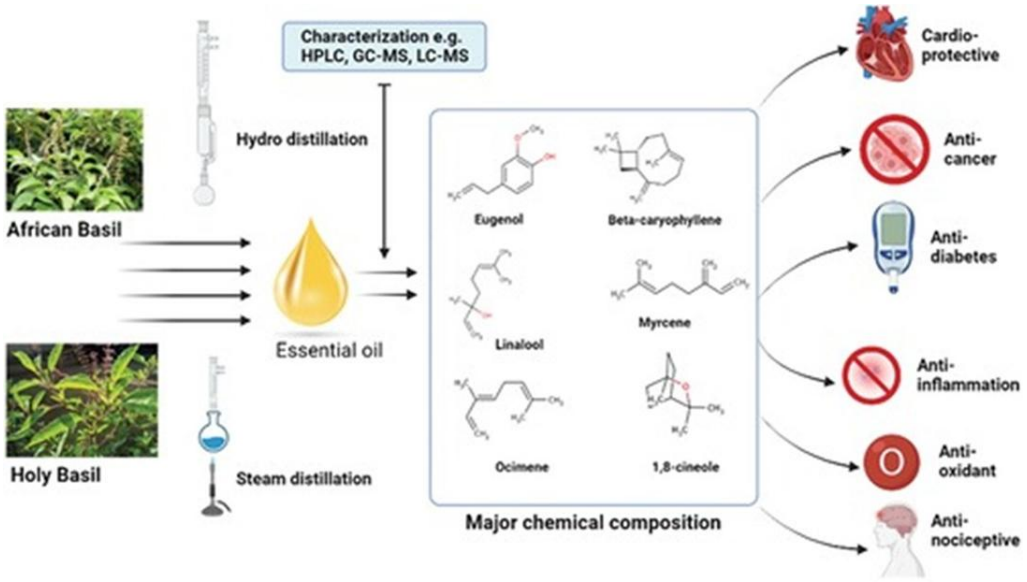
Another study examined the effects of pre- and co-treatment of O. sanctum L. hydroalcoholic extract at various doses (25, 50, 75, 100, 200, and 400 mg/kg) against rat myocardial infarction caused by isoproterenol (ISO, 20 mg/kg, Sc). At doses of 25, 50, 75, and 100 mg/kg, O. sanctum L. significantly lowered superoxide dismutase, glutathione (GSH), and lactate dehydrogenase levels. The highest cardioprotective effect of O. sanctum L. was reported to occur at a dose of 50 mg/kg in this investigation.

Heart lipid membrane peroxidation resulted from the drug induced oxygen radicals that were produced in the heart cells. It has been discovered that ursolic acid (UA), which was extracted from Oryza sanctum L., protects against lipid peroxidation caused by Adriamycin (ADR). In liver and heart microsomes, protection with UA was 13 and 17%, respectively. It rose to 69% when combined with oleanolic acid (OA) that was extracted from Eugenia jumbolata. [12]

5.Improve Immunity:

The herb Tulsi (*Ocimum sanctum* Linn.) is highly revered, and it has long been traditionally believed that consuming Tulsi leaves on an empty stomach can help enhance immunity. Experimental studies have shown that alcoholic extracts of Tulsi are capable of modulating immune responses.

In a 4-week intervention study, the group receiving Tulsi extract showed a statistically significant increase in the levels of IFN-γ ($p = 0.039$) and IL-4 ($p = 0.001$), along with a rise in the percentages of T-helper cells ($p = 0.001$) and natural killer (NK) cells ($p = 0.017$) when compared with the placebo group. These results strongly indicate that Tulsi leaf extract exerts a measurable immunomodulatory effect in healthy individuals. [12]



❖ **Nuitrient Value of Tulsi**

A nutrition table showing the nutrient content of a food (likely per 100 g)

Overall composition:

- Very high in **water** (~92%), so it's a hydrating, low-calorie food
- Low in **energy** (94 kJ)
- Contains small amounts of **carbohydrates (2.65 g)**, **protein (3.15 g)**, and very little **fat (0.64 g)**
- Has some **dietary fiber (1.6 g)**

Vitamins:

- Notable amount of Vitamin K (414.8 µg) — quite high
- Good levels of Vitamin A (264 µg) and Vitamin C (18 mg)
- Contains smaller amounts of B vitamins (like thiamine, riboflavin, niacin, B6)
- Includes Vitamin E in small quantity

Minerals:

- Provides calcium (177 mg) and potassium (295 mg)
- Moderate magnesium (64 mg) and iron (3.17 mg)
- Very low sodium (4 mg) — good for low-salt diets
- Contains trace minerals like **zinc** and **manganese**.[13]

CONCLUSION

In conclusion, a wide body of pharmacological evidence supports *Ocimum sanctum* L. (Tulsi) as a potent adaptogenic and homeostatic herb. Its broad spectrum of activity across multiple physiological systems—including neuroprotective, metabolic, cardiovascular, and immunomodulatory effects—reinforces its traditional reputation as a plant that helps restore internal balance rather than simply alleviating symptoms.

Holy basil is known to contain several bioactive phytochemicals that may contribute to its strong anti-tumor potential, including activity relevant to cancer-related conditions. Traditionally, extracts of Tulsi have been used in the management of seasonal and infectious illnesses such as colds, coughs, various types of fevers including malaria and dengue, as well as respiratory disorders like bronchitis, asthma, and influenza.

Furthermore, *Ocimum sanctum* extracts have been reported to exhibit multiple pharmacological actions, including anti-inflammatory, anti-thyroid, anti-cancer, anti-diabetic, antioxidant, antimicrobial, and anthelmintic properties. Tulsi juice has also been used in traditional practices for

addressing vascular and cardiac disorders, eye-related conditions, and infections of the oral cavity and teeth.

In addition, Tulsi has been noted for its radioprotective properties and its ability to modulate immune function, thereby supporting overall physiological resilience. Taken together, these findings highlight the considerable therapeutic significance of this sacred plant, and justify continued scientific investigation into its medicinal potential for human health. Moreover, Tulsi extracts have demonstrated antiviral activity, suggesting possible usefulness in managing various viral infections. Overall, this review underscores the diverse and valuable therapeutic properties of holy basil.

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