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## ***OCIMUM SANCTUM*: A MEDICINAL GIFT FROM NATURE**

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**ABSTRACT:** *Ocimum sanctum* described as a sacred and medicinal plant in ancient literature, commonly known as Tulsi is derived from 'Sanskrit,' which means "the incomparable one." This plant belongs to the family Lamiaceae which is native throughout the old world tropics and cultivated for religious and medicinal purposes. Several medicinal properties have been attributed to the plant not only in Ayurveda and Siddha but also in Greek, Roman, and Unani. It is widely known across South Asia as a medicinal plant and an herbal tea. Medicinal properties of Tulsi (*Ocimum sanctum* Linn.) are known for a thousand years to various civilizations of the world. This medicinal herb is considered as a sacred plant by the Hindus in the Indian subcontinent. Scientific explorations of traditional belief of medicinal properties of Tulsi have got momentum mostly after the middle of the 20<sup>th</sup> century. The wide numbers of phytochemical constituents have been isolated from the plant, e.g., aesculetin, orientin, vallinin, eugenol, alkaloids and is proved to have the potential for medical effects like hepatoprotective, neuroprotective, cardioprotective, chemopreventive, immunomodulatory, antioxidant, antimicrobial, anticancer, antiulcer, anti-inflammatory, antipyretic and various other important medicinal properties.

**INTRODUCTION:** Tulsi is an essential symbol of the Hindu religious tradition. Although, the word 'Tulsi' gives the implication of the incomparable one, its other name, Vishnupriya means the one that pleases Lord Vishnu. Found in most of the Indian homes and worshipped, its legend has permeated Indian ethos down the ages. Known in English as Holy Basil and botanically called *Ocimum sanctum*, Tulsi belongs to plant family Lamiaceae.

It has made significant contribution to the field of science from ancient times as also to modern research due to its large number of medicinal properties<sup>1</sup>. Tulsi has been described as of two types- vanya (wild) and gramya (grown in homes). Although having same usage, the former has darker leaves. Tulsi is a popular home remedy for many ailments such as a wound, bronchitis, liver diseases, catarrhal fever, lumbago, hiccough, ophthalmia, gastric disorders, genitourinary disorders, skin diseases, various forms of poisoning and psychosomatic stress disorders<sup>2</sup>.

It also has aromatic, stomachic, carminative, demulcent, diaphoretic, diuretic, expectorant, alexiteric, vermifuge and febrifuge properties. Given these facts, an attempt has been made to

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review the various pharmacological activities of OS based on the experimental and clinical studies reported in different kinds of literature. Tulsi grows wild in the tropics and warm regions. The plant is distributed and cultivated throughout India. It is an erect, much branched, fragrant and erected plant attaining a height of about 30-60 cm when mature. Its aromatic leaves are simple, opposite, elliptic, oblong, obtuse or acute with entire or substrate or dentate margins, growing up to 5 cm long. The Tulsi flowers are small, purplish in elongate racemes in close whorls. The fruits are small, and the seeds are reddish-yellow. The plant is bitter and acrid<sup>3</sup>. In Ayurveda, tulsi has been well known for its therapeutic potentials and described as Dashemani Shwasaharni (antiasthmatic) and antiseptic drugs (Kaphaghna)<sup>4</sup>.

Tulsi is described as a sacred and medicinal plant in ancient literature. The name Tulsi is derived from 'Sanskrit,' which means "matchless one." This plant belongs to the family Labiatae, characterized by the square stem and specific aroma. Botanical name of Tulsi is *Ocimum sanctum* (Linn). In India, the plant is grown throughout the country from Andaman and Nicobar islands to the Himalayas up to 1800 meters above the sea level. It is also abundantly found in Malaysia, Australia, West Africa and some of the Arab countries. *Ocimum sanctum* (Linn.) is the most prominent species of the genera. The leaves of the plant are considered to be very holy and often form a consistent part of the Hindu spiritual rituals (Tirtha or Prasada). *Ocimum sanctum* has two varieties, *i.e.*

the black (Krishna Tulsi) and green (Rama Tulsi), their chemical constituents are similar. Both the varieties also have common medicinal properties<sup>5</sup>.

Three varieties of Tulsi are:

- Rama or Light Tulsi (*Ocimum sanctum*)
- Shyama or Dark Tulsi (*Ocimum sanctum*)
- Vana Tulsi (*Ocimum gratissimum*)

#### Plant Anatomy:

Kingdom: Plantae  
 Division: Magnoliophyta  
 Class: Magnoliopsida  
 Order: Lamiales  
 Family: Lamiaceae  
 Genus: *Ocimum*  
 Species: *tenuiflorum*  
 Bot. Name: *O. tenuiflorum*

**Morphology:** It is an erect, herbaceous, more-branched, softy hairy, biennial or triennial plant, 30-75 cm high. The leaves are elliptic-oblong, acute or obtuse, entire or serrate, pubescent on both sides, minutely gland-dotted; the flowers are purplish or crimson, in racemes, close whorled; the nut-lets are sub-globose or broadly ellipsoid, slightly compressed, nearly smooth, pale-brown or reddish with small, black markings<sup>4</sup>.

**Synonyms:** The Tulsi has different names in the various parts of India that are shown in the following **Table 1**.<sup>5</sup>

**TABLE 1: SYNONYMS OF TULSI IN INDIAN LANGUAGES**

S. No.	Name	Language	State/Region
1	Tuloxi, Tulasii	Assamese	Assam , North-East India
2	Tulsi, Kalotulsi, Kural	Bengali	West Bengal
3	Tulsi, Niyam Posh	Dogri	Himachal Pradesh
4	Sabje, Talasi	Gujarati	Gujarat
5	Karitulasi,, Tulasiya	Kannada	Karnataka
6	Pachcha, Kunnakam	Malayalam	Kerala
7	Mayangton, Naoshek lei	Manipuri	North-eastern India
8	Sabja, Talsa	Marathi	Maharashtra
9	Dhala Tulasi, Karpura	Oriya	Orissa
10	Tulsi	Punjabi	Punjab
11	Tulsi, Manjari, Ajaka	Sanskrit	India, Nepal, Bangladesh
12	Tiruttizhai, Tiviragandam	Tamil	Tamil Nadu
13	Oddhi, Rudrajada	Telugu	Andhra Pradesh
14	Tulsi, Janglitulsi	Urdu	Kashmir, North India

**Hinduism:** Tulsi or Tulasi is a sacred plant for Hindus. Water mixed with Tulsi petals is given to the dying to raise their departing souls to heaven. Tulsi, which is Sanskrit for "the incomparable one," is worshipped throughout India, most often regarded as a consort of Krishna in the form of Lakshmi. According to Brahma Vaivarta Purana tulsi is an expression of Sita. There are two types of tulsi worshipped in Hinduism: "Rama Tulsi" has light green leaves and is larger in size; "Shyama tulsi" has dark green leaves and is important for the worship of Hanuman.

Many Hindus have tulsi plants growing in front of or near their home, often in individual pots. Traditionally Tulsi is planted in the center of the central courtyard of Hindu houses. It is also frequently grown next to Hanuman temples, especially in Varanasi. In the ceremony of Tulsi Vivah, Tulsi is ceremonially married to Krishna annually on the eleventh day of the waxing moon or twelfth of the month of Kartika in the lunar calendar. This day also marks the end of the four-month Cāturmāsya period, which is considered inauspicious for weddings and other rituals, and so the day inaugurates the annual marriage season in India. The ritual lighting of lamps each evening during Kartika includes the worship of the tulsi plant, which is held to be auspicious for the home. Vaishnavas especially follow the daily worship of Tulsi during Kartika<sup>6</sup>.

**Cultural Importance:** Tulsi is the sacred plant dearer to the Lord Vishnu. Tulsi symbolizes purity. It is considered as the holy plant in the Indian Subcontinent. Tulsi got its name from Tulasi Devi, who was one of Lord Krishna's eternal consorts. In India, people grow Tulsi as a religious plant and worship it. Its leaves are used in temples for worship purposes and also on several occasions such as marriage<sup>7</sup>.

**Phytoconstituents:** The leaf of OS contains 0.7% volatile oil comprising about 71% eugenol and 20% methyl eugenol. The oil also contains carvacrol and sesquiterpene hydrocarbon caryophyllene<sup>8</sup>. Fresh leaves and stem of OS extract yielded some phenolic compounds (antioxidants) such as curvilinear, circumarctic, isothymusin, apigenin and rotameric acid and appreciable quantities of eugenol, two flavonoids,

viz., orientin and vicenin from aqueous leaf extract of OS have been isolated ursolic acid, apigenin, luteolin, apigenin-7-O-glucuronide, luteolin-7-O-glucuronide, orientin, and molludistin have also been isolated from the leaf extract<sup>7</sup>. OS also contains a number of sesquiterpenes and monoterpenes viz., bornyl acetate,  $\alpha$ -elemene, neral,  $\alpha$ - and  $\beta$ -pinenes, camphene, campesterol, cholesterol, stigmasterol, and  $\beta$ -sitosterol<sup>9</sup>.

### Pharmacological Activities:

**Anti-cancer Activity:** Herbal anti-cancer compounds are unique in their feature of having antioxidant & immunostimulant activity preventing cancer growth indirectly along with a direct cytotoxic effect towards malignant and other apoptotic cells. *Ocimum sanctum* is beneficial against stress and depression during the tumor. Human fibrosarcoma cells in culture treated with an ethanolic extract of *Ocimum sanctum* induced cytotoxicity at 50 $\mu$ g/ml and above. Morphologically the cells showed shrunken cytoplasm and condensed nuclei.

The cells also showed depleted intracellular glutathione and increased levels of lipid peroxidation products. Administration of aqueous and ethanolic extracts of *O. sanctum* to mice bearing Sarcoma-180 solid tumors mediated a significant reduction in tumor volume and an increase in lifespan. These observations indicate *O. sanctum* extracts possess anticancer activity. Anti-inflammatory and antioxidant activities are also important in preventing the proliferation of certain cancer cell lines. Curcumin and ursolic acid in *O. sanctum* is known to have anti-inflammatory, cyclo-oxygenase inhibitory and antioxidant activities. A study reported that administration of *Ocimum sanctum* to mice significantly elevated glutathione and more than 78% glutathione-S-transferase activity. These effects could enhance survival though it may not affect the tumor directly.

The antitumor activity and chemopreventive potential of *O. sanctum* was evaluated using Dalton Lymphoma ascites tumor model in Swiss Albino mice. Oral administration of crude herb increased the survival time and decreased the peritoneal ascitic fluid content significantly. DMBA (7, 12-dimethylbenz [a] anthracene) induced rat hepatocytes pretreated with *O. sanctum* extract

showed a significant reduction in the levels of DMBA-DNA adducts. The results suggest that *O. sanctum* leaf extract blocks or suppresses the events associated with chemical carcinogenesis by inhibiting metabolic activation of the carcinogen. The seed oil of *O. sanctum* was evaluated for chemopreventive activity against subcutaneously injected 20- methylcholanthrene induced-fibrosarcoma tumors in the thigh region of Swiss albino mice. The enhanced survival rate and delay in tumor incidence were observed in seed oil supplemented mice.

Liver enzymatic and lipid peroxidation end product, malondialdehyde levels were significantly modulated with oil treatment as compared to untreated 20- methylcholanthrene injected mice. The results of this study suggest that the potential chemopreventive activity of the oil is partly attributable to its antioxidant properties and it significantly reduced tumor size and volume. The radioprotective effect of *O. sanctum* on the salivary gland of rats administered radioiodine [(131)I] and compared its efficacy with a known radioprotectant, amifostine. *O. sanctum* and amifostine pre-supplemented and subsequently exposed to [(131)I] rats at 3 and 6 months duration exhibited comparable histopathology with controls indicating the possible radioprotective effect against high doses of [(131)I] exposure<sup>9</sup>.

**Antioxidant Activity:** Antioxidants may be defined as compounds that inhibit or delay the oxidation of other molecules by inhibiting the initiation or propagation of oxidizing chain reactions.<sup>10</sup> It has been investigated for its antioxidant activity and found to offer substantial protection against free radical-induced damage in rat liver microsomes. More studies revealed that *Ocimum sanctum* decreased lipid peroxidation and increased the activity of superoxide dismutase<sup>11</sup>.

The antioxidant properties of flavonoids and their relation to membrane protection have been observed. 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. OS extract has significant ability to scavenge highly reactive free radicals. 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<sup>1,12</sup>.

**Chemopreventive Activity:** The chemopreventive effect of OS leaf extract is probably through the induction of hepatic/extrahepatic GST in mice. Elevated levels of reduced GSH in liver, lung and stomach tissues in OS extract supplemented mice were also found<sup>13</sup>. Significant antiproliferative and chemopreventive activities were observed in mice with a high concentration of OS seed oil. The potential chemopreventive activity of seed oil has been partly attributed to its antioxidant activity<sup>14,15</sup>.

**Radioprotective Activity:** The radioprotective effect of OS was firstly reported in the year 1995. Two isolated flavonoids, *viz.*, orientin and vicenin from OS leaves showed a 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, nontoxic concentrations. 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<sup>16,17</sup>.

**Tulsi as a Prophylactic Agent:** The decoction of leaves is used against gastritis and hepatic disorders. The juice of fresh leaves is also given to patients to treat dysentery. In a study, it has been found that methanolic extract of *Ocimum suave* showed a healing effect against chronic gastric ulcers induced in experimental rats. *Ocimum sp.* along with pepper, turmeric and onion are prophylactic against malaria. Oil is insecticidal and larvicidal. It contains: b-bisabolene (13-20%), methyl chavicol (3-19%), 1, 8-cineole (9-33%), eugenol (4-9%), (E)-a-bisabolene (4-7%) and a-terpineol (1.7-7%) are the main constituents of tulsi oil<sup>18</sup>. Often, Tulsi is planted in Indian gardens as a mosquito repellent.

Essential oils of Tulsi possess 100 % larvicidal property. It has been found that Tulsi has excellent anti-malarial properties as well. Eugenol is the

main constituent, and it is responsible for its repellent property. Paste prepared from Tulsi leaves is used against the ringworm infection. Tulsi removes worms and parasites. Tulsi extract with honey is recommended so that the parasites may be excited, thus drawing them out of their hiding places.

The paste of its leaves is applied on the face to clear marks. Ursolic acid present in leaves returns elasticity and removes wrinkles. Tulsi helps skin stay healthy and supple. Use of Tulsi in the treatment of all kinds of cuts, wounds, and ulcers is highly beneficial. The leaf juice of tulsi along with Triphala is used as an eye tonic and is recommended for glaucoma, cataract, chronic conjunctivitis and other diseases associated with eyes. Chewing 3-4 of leaves before a meal helps to stimulate the appetite, and a tea taken after a meal promotes digestion by increasing the flow of gastric juices, while reducing gas and bloating. *Ocimum sanctum* also reduces the chances of ulcers.

It is an active diaphoretic common cold. It removes excess cough from lungs and nasal passages. A decoction of Tulsi leaves a popular remedy for the common cold in India. It is also given for fever along with the clove. It also lowers the uric acid levels and hence is considered as a potential anti-inflammatory agent. The leaves of basil are specific for many fevers. During the rainy season, when malaria and dengue fever are widely prevalent, tender leaves, boiled with tea, act as preventive against these diseases. In the case of acute fevers, a decoction of the leaves boiled with powdered cardamom brings down the temperature; thereby it has been considered as a potential antipyretic cocktail as a home remedy.

Tulsi is an important constituent of many cough syrups and expectorants. It helps to mobilize mucus in bronchitis and asthma. Chewing tulsi leaves relieves cold and flu. The leaves are nerve tonic and also sharpen memory. They promote the removal of the catarrhal matter and phlegm from the bronchial tube. It is useful in teeth disorders and is also recommended as a remedy against pyorrhea. Also, it is used as a remedy for night blindness and conjunctivitis. Being nerve tonic the leaves are used to sharpen memory.

It is a good source of antioxidants and offers substantial protection against free radical-induced damage. Oxygen free radicals are natural physiological products, containing one or more unpaired electrons. Reactive oxygen species (ROS) may damage life essential membrane lipids, proteins, DNA and carbohydrates. This damage has been implicated in the causation of several diseases such as liver cirrhosis, atherosclerosis, cancer, and diabetes, etc. It has been well accepted that dietary antioxidants have great potential in ameliorating these disease processes.

Antioxidants thus play an important role in protecting the human body against damage by reacting oxygen species. It also decreases the lipid peroxidation and increases the activity of superoxide dismutase. Presence of eugenol attributes to its anti-oxidative property and is also thought to be responsible for inhibition of lipid peroxidation. This property helps in maintaining good health and in preventing the chances occurrence of heart diseases as well as most of the other biochemical diseases because oxidative stress is the hallmark of such diseases<sup>19-28</sup>.

#### **Antihypertensive & Cardioprotective Activities:**

The transient cerebral ischemia and long term cerebral hypoperfusion (causing cellular edema, gliosis and perivascular inflammatory infiltrate) have been prevented by OS. The OS fixed oil administered intravenously produced a hypotensive effect in the anaesthetized dog, which seems to be due to its peripheral vasodilatory action. Essential fatty acids like linoleic and linolenic acids, contained in the OS oil produce series 1 and 3 (PGE1 and PGE3) prostaglandins and inhibit the formation of series 2 prostaglandins (PGE2). The long term feeding of OS offers significant protection against isoproterenol-induced myocardial necrosis in Wistar rats through enhancement of endogenous antioxidant<sup>29-31</sup>.

#### **Central Nervous System (CNS) Depressant Activity:**

The alcoholic extract 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 antistress activity. The effect was comparable to that of desipramine, an antidepressant drug. OS fixed oil (2-3 ml/kg, IP) has been reported to increase pentobarbitone-induced sleeping time in rats. The inhibition of hepatic metabolism of pentobarbitone / renal clearance by fixed oil could be responsible for the potentiation of pentobarbitone-induced sleeping time<sup>7</sup>.

**Anti-lipidemic Efficacy:** Hyperlipidemia, atherosclerosis and related diseases are becoming a major health problem nowadays. Aqueous extract of *O. basilicum* reduces the level of total cholesterol, triglycerides and LDL-cholesterol levels in acute hyperlipidemia induced by Triton WR-1339 in rats.<sup>32</sup> In a study conducted on rabbits, a diet supplemented with 1-2 % fresh leaves of Tulsi for 28 days lowered the total lipid<sup>33</sup>.

**Analgesic Activity:** An analgesic, or painkiller, is any member of the group of drugs used to achieve analgesia-relief from pain<sup>34</sup>. It may also be defined as a drug bringing about insensibility to pain without loss of consciousness<sup>35</sup>. 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<sup>36</sup>.

**Anti-inflammatory Activity:** Methanolic extract (500 mg/kg) and an aqueous suspension of OS showed analgesic, antipyretic and anti-inflammatory effects in acute (carrageenan-induced pedal edema) and chronic (croton oil-induced granuloma and exudate formation) inflammations in rats. The fixed oil and linolenic acid possess significant anti-inflammatory activity against PGE<sub>2</sub>, leukotriene, and arachidonic acid-induced paw edema in rats by their capacity to block both the cyclooxygenase and lipoxygenase pathways of arachidonic acid metabolism<sup>37,38</sup>.

**Antipyretic Activity:** The antipyretic activity of OS fixed oil was evaluated by testing it against typhoid-paratyphoid A/B vaccine-induced pyrexia

in rats. The oil on ip administration considerably reduced the febrile response indicating its antipyretic activity. At a dose of 3 ml/kg, the antipyretic activity of the oil was comparable to aspirin. Further, the fixed oil possessed prostaglandin inhibitory activity and the same could explain its antipyretic activity<sup>39</sup>.

**Anti-bacterial, Anti-viral and Anti-fungal Activities:** Essential oil present in most of the *Ocimum species* is responsible for its antifungal, antibacterial and antiviral properties. Microorganisms develop resistance against various antibiotics, and due to this, an immense clinical problem develops in the treatment of infectious diseases. Medicinal plants can be used to overcome this problem. Tulsi leaves have been reported to show strong antifungal activities against the *Aspergillus species*. *In-vitro* antifungal activity was also observed against *Candida species* also when oil from *O. gratissimum* L. was used. *Ocimum* shows strong antibacterial activity against *Klebsiella* (causes pneumonia and urinary tract infections), *E. coli*, *Proteus* & *Staphylococcus aureus*, and *Vibrio cholerae*. Studies have shown *O. basilicum* act as a strong antiviral agent against DNA viruses (herpes viruses (HSV), adenoviruses (ADV) and hepatitis B virus) and RNA viruses (coxsackievirus B1 (CVB1) and enterovirus71 (EV71)). *O. tenuiflorum* also has been reported to be having antiviral activity against bovine herpesvirus -1. Essential oil from *Ocimum sp.* which contain eugenol, carvacrol, methyl eugenol, caryophyllene are considered mainly to be responsible for various antimicrobial properties<sup>24,40,41</sup>.

**Anti-diabetic Activity:** Oral administration of OS extract led to a marked lowering of blood sugar in normal, glucose-fed hyperglycemic and streptozotocin-induced diabetic rats. A randomized, placebo-controlled, cross over single-blind human trial indicated a significant decrease in fasting and postprandial blood glucose levels by 17.6% and 7.3%, respectively. Urine glucose levels showed a similar trend. Further, OS has aldose reductase activity, which may help in reducing the complications of diabetes such as cataract, retinopathy, etc.<sup>42,43,44</sup>

**Anti-fertility Agent:** One of the major constituents of the Tulsi leaves ursolic acid, and it has been

reported that it possess an anti-fertility effect. This effect has been attributed to its anti-estrogenic activity which may be responsible for the arrest of spermatogenesis in males and due to the inhibitory effect on implantation of the ovum in females. This constituent may prove to be a promising anti-fertility agent devoid of side effects. In males, Tulsi leaves reduce spermatogenesis by retarding Sertoli cells activity. The leaves of *O. canum* have been shown to possess anti-implantation activity in experimental albino rats. Ursolic acid is responsible for its anti-sterility property. Tulsi leaves have antiandrogenic property as well. Benzene extract of *O. sanctum* in Albino rats decreases the total sperm count and sperm motility<sup>45</sup>.

**Immunomodulatory Activity:** Steam distilled extract from the fresh leaves of OS showed a modification in the humoral immune response in albino rats which could be attributed to such mechanisms as antibody production, the release of mediators of hypersensitivity reactions and tissues responses to these mediators in the target organs. OS seed oil appears to modulate both humoral and cell-mediated immune responsiveness, and GABAergic pathways may mediate these immunomodulatory effects<sup>46,47</sup>.

**Memory Enhancer Activity:** The AIE of the whole dried plant of OS ameliorated the amnesic effect of scopolamine (0.4 mg/kg) and aging-induced memory deficits in mice. Passive avoidance paradigm served as the exteroceptive behavioral model. OS extract increased step-down latency (SDL) and acetylcholinesterase inhibition significantly. Hence, OS can be employed in the treatment of cognitive disorders such as dementia and Alzheimer's disease<sup>48</sup>.

**Hepatoprotective Activity:** Oral administration of a 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/100 g, orally for 6 days) of OS was found to be effective against carbon tetrachloride (0.2ml/100g, subcutaneously) induced liver damage in Albino rats<sup>1</sup>.

**Anti-ulcer Activity:** The fixed oil of OS administered intraperitoneally elicited significant antiulcer activity against aspirin, indomethacin,

alcohol (ethanol 50%), histamine, reserpine, serotonin or stress-induced ulcers in rats. The fixed oil significantly possessed antiulcer activity due to its lipooxygenase inhibitory, histamine antagonistic and antisecretory effects<sup>39,49</sup>.

**Anti-arthritis Activity:** The antiarthritic activity of OS fixed oil was evaluated against formaldehyde-induced arthritis in rats. The fixed oil significantly reduced the diameter of the inflamed paw. On intraperitoneal administration of the fixed oil daily for 10 days, there was a marked improvement in the arthritic conditions in rats. The antiarthritic effect at 3 ml/kg dose was comparable to aspirin @ 100 mg/kg, i.p.<sup>38</sup> The fixed oil inhibited carrageenan and inflammatory mediators (e.g., serotonin, histamine, bradykinin, and PGE2) induced inflammation. It is natural that the oil could inhibit an inflammatory response involving these mediators. The result suggests the potentially useful antiarthritic activity of the inflammation models, including adjuvant as well as turpentine oil-induced joint edema in rats<sup>50</sup>.

**Adaptogenic Activity/ Anti-stress Activity:** Stress is a common phenomenon that is experienced by every individual. Stress is defined as "the nonspecific result of any demand upon the body." Stress can be either physical or psychological. When stress becomes extreme, it is harmful to the body and, hence, needs to be treated. Stress is involved in the pathogenesis of a variety of diseases that includes psychiatric disorders such as depression and anxiety, immunosuppression, endocrine disorders including diabetes mellitus, male impotence, cognitive dysfunction, peptic ulcer, hypertension, and ulcerative colitis. Tulsi is an excellent rejuvenator, which has been known to help reduce stress, relax the mind and assist the body in improving memory. Tulsi has antihypoxic effect, and it increases the survival time during anoxic stress.

A study conducted with rabbits has suggested that Tulsi decreased oxidative stress. Tulsi leaves are regarded as an 'adaptogen' or anti-stress agent. Recent studies have shown that the leaves afford significant protection against stress. If taken twice a day, Tulsi is a powerful calming herb. It also counteracts many troublesome effects of chronic stress, including nervousness, sleeplessness, and

digestive disorders. Animal research has verified that extracts of Tulsi leave prevented changes in plasma levels of the stress hormone corticosterone induced by both acute and chronic noise stress<sup>51, 52, 53</sup>.

**Anti-cataract Activity:** The aqueous extract 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<sup>3</sup>.

**Anti-coagulant Activity:** The OS fixed oil (3 ml/kg, ip) prolonged blood clotting time and the response was comparable to that obtained with aspirin (100 mg/kg). The effect appears to be due to the anti-aggregatory action of oil on platelets<sup>30</sup>.

**Toxicity:** The median lethal dose (LD<sub>50</sub>) of OS fixed oil was determined after i.p. 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 LD<sub>50</sub> of oil was 42.5 ml/kg. There was found no untoward effect on sub-acute toxicity study of OS fixed oil at a dose of 3 ml/kg/day, i.p. for 14 days in rats<sup>39</sup>.

#### Health Benefits of Basil (Tulsi):

1. Healing Power
2. Fever & Common Cold
3. Coughs
4. Sore Throat
5. Respiratory Disorder
6. Kidney Stone
7. Heart Disorder
8. Children's Ailments
9. Stress
10. Mouth Infections
11. Insect Bites
12. Skin Disorders
13. Teeth Disorder
14. Headaches
15. Eye Disorders.<sup>6</sup>

**CONCLUSION:** There are thousands of herbal plants in the world, but the Tulsi is considered to be the queen of herbs due to its greater medicinal values. In reviewing the detailed study as above, it can be concluded that the *Ocimum sanctum* or Tulsi is a traditionally and clinically proved medicinal herb for both its applications and efficacy. The broad survey of the literature showed that *Ocimum sanctum* has a vast spectrum of pharmacological activities and it can be considered as a medicinal gift from nature.

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