



# International Journal of Pharmaceutical and Phytopharmacological Research (eIJPPR)

[Impact Factor – 0.7826]

Journal Homepage: [www.eijppr.com](http://www.eijppr.com)

## Review Article

# *Ocimum sanctum* Linn: A Review on Phytopharmacology and Therapeutic Potential of Tulsi

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### Article info

Article History:  
Received 30 September 2013  
Accepted 20 October 2013

Keywords:  
*Ocimum sanctum*, Tulsi,  
Chemical constituents, Medicinal  
properties

### Abstract

World health organization (WHO) has advocated the evaluation of therapeutic potential of plants for diseases where we lack safe allopathic drugs. *Ocimum sanctum* described as 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. The chemical constituents isolated from various parts of the plant include eugenol, cardinene, cubenol, borneol, linoleic acid, linolenic acid, oleic acid, palmitric acid, steric acid, Vallinin, Vicenin, Vitexin, Vallinin acid, Orientin, Circineol, Gallic Acid, vitamin A, vitamin C, phosphorous and iron. *Ocimum sanctum* has been shown to possess multifarious medicinal properties such as analgesic activity, anti-ulcer activity, immunomodulatory activity, antiasthmatic activity, anticancer activity, anticonvulsant activity, antidiabetic activity, antihyperlipidemic activity, antistress activity in addition to possessing useful memory enhancer and neuroprotective activity. The present review article provides up-to-date information on the therapeutic potential of tulsi. This review article will help the scientists working in the area of traditional medicines and medicinal food in their research.

## 1. INTRODUCTION

Plants are of the important sources of medicine and a large number of drugs in use are derived from plants. The therapeutic uses of plant are safe, economical and effective as their ease of availability<sup>1</sup>. Among the plants known for medicinal value, the plants of genus *Ocimum* belonging to family Lamiaceae are very important for their therapeutic potentials. *Ocimum sanctum* (Fig.1) has two varieties i.e. black (*Krishna Tulsi*) and green (*Rama Tulsi*), their chemical constituents are similar<sup>2</sup>. *Ocimum sanctum* is widely distributed covering the entire Indian sub continent, ascending up to 1800 m in the Himalayas and as far as the Andaman and Nicobar Island<sup>3</sup>. Tulsi is a Sanskrit word which means "the incomparable one" and has a very special place in the Hindu culture. Various synonyms used in India (refer table 1) and all over the world (refer table 2) for *Ocimum sanctum* have also been enumerated in this review article. The phytoconstituents isolated from various parts of the plant include eugenol, cardinene, cubenol, borneol, linoleic acid, linolenic acid, oleic acid, palmitric acid, steric acid, Vallinin, Vicenin, Vitexin, Vallinin acid, Orientin, Circineol, Gallic Acid, vitamin A, vitamin C, phosphorous and iron (refer table 3). *Ocimum sanctum* is one such plant showing multifarious medicinal properties viz. analgesic activity, Immunomodulatory activity, antiasthmatic activity, anticancer activity, anticonvulsant activity, antidiabetic activity, antihyperlipidemic activity, antistress activity in addition to possessing useful memory enhancer and neuroprotective activity etc. (refer table 4). This review article summarises various phytoconstituents present in *Ocimum sanctum*, enlists various biological activities of *Ocimum sanctum*.

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## 2. BIO-POTENTIAL OF TULSI

### 2.1 Analgesic Activity

Singh et al., in 1995 studied the Analgesic activity of fixed oil from the seeds of *Ocimum sanctum* (OS) in mice and rats using the tail flick, tail clip, tail immersion and acetic acid-induced writhing methods. It was found to be effective against acetic acid induced writhing in dose dependent manner suggesting that writhing inhibiting activity of the oil is peripherally mediated due to combined inhibitory effects of prostaglandins, histamine and acetylcholine.

### 2.2 Antiasthmatic Activity

50% aqueous ethanol extract of dried and fresh leaves and the volatile and fixed oils of OS was evaluated against histamine and acetylcholine induced pre-convulsive dyspnea (PCD) in guinea pigs. The 50% ethanol extract and volatile oil extracted from fresh leaves and fixed oil from the seeds significantly protected the guinea pigs against histamine and acetylcholine induced pre-convulsive dyspnea. However, the 50% ethanol extract of dried leaves did not protect the guinea pigs against histamine induced preconvulsive dyspnea<sup>9</sup>.

### 2.3 Antibacterial Activity

Antibacterial activity of the aqueous, alcoholic, chloroform extract and oil obtained from leaves of *Ocimum sanctum* were studied against *E.coli*, *P.aeruginosa*, *S. typhimurium* and *S.aureus*. Extract obtained from OS were observed equally effective against pathogenic gram-positive and gram-negative bacteria<sup>10</sup>.

### 2.4 Anticancer Activity

Antimelanoma activity of 50% alcoholic aqueous leaf extract of different species of *Ocimum* was studied by Monga et al. in 2011. Leaf extract administered orally (200mg/kg, p.o.) resulted in significant reduction in tumor volume, increase in average body weight and survival rate of mice<sup>11</sup>.

### 2.5 Anticataleptic Activity

Aswar et al in 2010 studied the anticataleptic activity of the aqueous extract (300 mg/kg, i.p) and the alcoholic extract (300 mg/kg, i.p) of the leaves of *Ocimum sanctum* and observed a significant ( $P < 0.001$ ) reduction in cataleptic scores<sup>12</sup>.

### 2.6 Anticonvulsant Activity

Different extractives of stem, leaf and stem callus of *Ocimum sanctum* were tested for anticonvulsant activity against standard drug phenytoin using maximal electroshock (MES) model. Ethanol and chloroform extractives of stem, leaf and stem calli were effective in preventing tonic convulsions induced by transcorneal electroshock<sup>13</sup>.

### 2.7 Antiemetic Activity

Tulsi leaves also check vomiting and used for antiemetic action<sup>14</sup>.

### 2.8 Anti-helminthic Activity

The essential oil of *Ocimum sanctum* and eugenol, tested in-vitro, showed potent anthelmintic activity in the *Caenorhabditis elegans* model<sup>15</sup>.

### 2.9 Antihyperlipidemic and Cardioprotective Activity

Suanarunsawat et al in 2010 studied the antihyperlipidemic and cardioprotective activity of *Ocimum sanctum* fixed oil in rats fed with a high fat (HF) diet and concluded that treatment with OS fixed oil decreased the high serum lipid profile and expressed antiatherogenic and cardioprotective actions against hyperlipidemia. The anti-hyperlipidemic action of OS fixed oil was mainly resulted from the suppression of liver lipid synthesis. Linolenic acid and linoleic acid contained in *Ocimum sanctum* fixed oil were possibly responsible for both lipid-lowering and cardiac protective action against hyperlipidemia<sup>16</sup>.

### 2.10 Antihypertensive Activity

The OS fixed oil administered i.v. produced hypotensive effect in anaesthetized dog which seems to be due to its peripheral vasodilatory action. Essential fatty acids like linoleic and linolenic acid contained in the OS oil produce series 1 and 3 (PGE1 and PGE3) prostaglandins and inhibit the formation of series 2 prostaglandins (PGE2)<sup>17</sup>.

### 2.11 Antistress Activity

Fresh leaves of *Ocimum sanctum* were evaluated for antistress activity against experimentally induced oxidative stress in albino rabbits by Jyoti et al in 2007<sup>18</sup>.

### 2.12 Antianxiety and Antidepressant Activity

Chatterjee et al in 2011 studied the effect of ethanolic extract of leaves of *Ocimum sanctum* in Swiss albino mice against both anxiety and depressive disorder. Depression was studied through tail suspension test and forced swim test. Anxiety experiments included light dark test, elevated plus maze test and hole board test. The *Ocimum sanctum* extracts shows antianxiety and antidepressant properties at the same dose and can be a potential therapeutic agent against mixed anxiety and depressive syndrome<sup>19</sup>.

### 2.13 Demulcent/Stimulant/Expectorant

Traditionally, juice of the leaves of OS plant was used as demulcent, stimulant and expectorant. The seeds are mucilaginous and demulcent and are given in different ailments of genito-urinary system. An infusion of leaf had been used as anti-spasmodic in gastric disorders of children<sup>2</sup>.

### 2.14 Eye Disease

The leaf juice of *Ocimum sanctum* along with triphala is used in ayurvedic eye drop preparations recommended for glaucoma, chronic conjunctivitis and other painful eye disease. In daily routine one may use about three drops of tulsi oil along with honey and it is supposed to improve eye sight<sup>20</sup>.

### 2.15 Hepatoprotective Activity

Lahon et al in 2011 studied hepatoprotective activity of *Ocimum sanctum* alcoholic leaf extract against paracetamol-induced liver damage in albino rats synergism with silymarin and concluded that

*Ocimum sanctum* alcoholic leaf extract showed significant hepatoprotective activity and synergism with silymarin<sup>21</sup>.

### 2.16 Immunomodulatory Activity

Jeba et al in 2011 studied that aqueous extract of *Ocimum sanctum* at the oral doses of 100, 200 mg/kg/day in rats enhances the production of RBC, WBC, haemoglobin and also enhanced the production of antibodies without affecting the biochemical parameters<sup>22</sup>.

### 2.17 Neuroprotective Activity

*Ocimum sanctum* shows ameliorative potential in attenuating vincristine induced peripheral neuropathic pain in rats which may be attributed to decrease in oxidative stress and calcium levels. Administration of OS (100 and 200 mg/kg p.o.) and its saponin rich fraction (100 and 200 mg/kg p.o.) for 14 days significantly attenuated vincristine-induced neuropathic pain along with decrease in oxidative stress and calcium levels<sup>23</sup>.

### 2.18 Radio-protective Activity

Joseph et al in 2011 studied the radioprotective effect of *Ocimum sanctum* on the salivary gland of rats administered radio iodine radio-protectant, amifostine. OS and amifostine presupplemented and subsequently exposed to (131) I rats at 3 and 6 months duration exhibited comparable histopathology with controls. The study indicated possible radioprotective effect of OS and amifostine against high-dose (131) I exposure<sup>24</sup>. Flavonoids extracted from the leaves of OS were studied as a radio-protector on the erythrocyte antioxidants in oral cancer. Results of the study suggest that erythrocytes from cancer patients responded to oxidative stress by elevating glutathione level while a decrease in glutathione levels observed in OS flavonoids treated patients could be due to the free radical scavenging effect of OS flavonoids, sparing the glutathione. However, OS flavonoids did not seem to exert its effect on other antioxidants of erythrocytes<sup>25</sup>.



Fig.1: Tulsi Plant

Table 1: Synonyms of Tulsi in Indian Languages

S. No.	Name	Language	State
1	Tulsi, kalotulsi, Kural	Bengali	West Bengal
2	Sabje, talasi	Gujarati	Gujarat
3	Pachcha, Kunnakam	Malayalam	Kerala
4	Mayangton, Naoshek lei	Manipuri	North eastern India
5	Sabja, Tulasa	Marathi	Maharashtra
6	Tulsi	Punjabi	Punjab
7	Tiruttzihai, Tiviragandam	Tamil	Tamil nadu
8	Oddhi, Rudrajada	Telugu	Andhra Pradesh
9	Karitulasai, Tulasiya	Kannada	Karnataka

**Table 2:** Synonyms of Tulsi in International Languages

S. No.	Name	Language	Country/Region
1	Laun, Pinzainpinzin	Burmese	Burma
2	Loh lahk, Yu heung choi	Chinese	China
3	Basilikum	Danish	Greenland
4	Baziel, Koningskrid	Dutch	South Africa
5	Basilie, Sweet basil	English	England
6	Basalic sacre, herbe royale	French	France
7	Indisches Basilikum	German	Germany
8	Besil, Tulsi, Jangli tulsi	Hindi	India
9	Basilika	Icelandic	Iceland
10	Basilico	Italian	Italy
11	Bajiru, kami-meboki	Japanese	Japan
12	Che tak, Mareah proeu	Khmer	Cambodia
13	Kemangi, selasi, jantan	Malay	Malaya
14	Tulsi patta, bavari phul	Nepali	Nepal
15	Madhuryala, Madhur tulla	Sinhalese	Sri Lanka
16	Hopara, Kaphrau	Thai	Thailand

**Table 3:** Phytochemicals Present in *Ocimum sanctum*

S. No.	Extracts	Phytochemicals	Plant Parts
1	Fixed oil <sup>4</sup>	Linoleic acid, Oleic acid, Palmitic acid, Stearic acid	Seeds
2	Essential oil <sup>5,6,7</sup>	Benzaldehyde, Borneol, bornyl acetate, Camphor, Caryophyllene oxide, cis- $\alpha$ -Terpineol, Cubenol, Furaldeheyde, Limonene, n-butylbenzoate, Ocimene, Oleic acid, sebinene, Phytol, Veidifloro, $\beta$ -Pinene, $\alpha$ -Thujjene, Methyl chavicol and linalool.	Leaves
3	Mineral Contents <sup>8</sup>	Vitamin C, Vitamin A, Calcium Phosphorous. Chromium, Copper, zinc, Iron.	
4	Alcoholic Extract <sup>2</sup>	Aesculin, Apigenin, Caffiieic acid, Chlorogenic Acid, Circineol, Gallic Acid, Isorientin, Luteolin, Molludistin, Procatechuic acid, Urosolic acid, Vallinin, Vallinin acid.	Leaves/ Areal parts

**Table 4:** Medicinal Properties of Tulsi

S. No.	Pharmacological Activity	Plant parts	Extracts
1	Analgesic Activity	Leaves/Seeds	Aqueous Suspension/Fixed oil
2	Antiasthmatic Activity	Leaves	Hydrochloric Extract
3	Antibacterial Activity	Leaves	Alcoholic Extract
4	Anticataleptic Activity	Leaves	Alcoholic Extract
5	Anticonvulsant Activity	Stem/Leaves	Alcoholic/Chloroform extract
6	Anti-helminthic Activity	Leaves	Essential oil
7	Antihyperlipidemic Activity	Seeds/leaves	Fixed oil, Essential oil
8	Antihypertensive Activity	Seeds	Fixed oil
9	Antistress Activity	Whole plant	Alcoholic extract
10	Antianxiety Activity	Leaves	Alcoholic extract
11	Antidepressant Activity	Leaves	Alcoholic extract
12	Anticancer Activity	Leaves	Alcoholic extract
13	Demulcent/stimulant/expectorant	Leaves	Leaf juice
14	Eye Disease	Leaves	Leaf juice
15	Immunomodulatory Activity	Leaves	Seed oil / Aqueous Extract
16	Neuroprotective Activity	Leaves	Alcoholic Extract
17	Radio-protective Activity	Leaves	Alcoholic Extract
18	Hepatoprotective	Seeds/Whole plant	Hydroalcoholic Acid

### 3. CONCLUSION

Plants have been used for the treatment of diseases throughout the world since the beginning of civilization. Tulsi is cultivated for religious and medicinal purposes. It is widely known across South

Asia as a medicinal plant and an herbal tea. Several medicinal properties have been attributed to the plant not only in Ayurveda and Siddha but also in Greek, Roman and Unani. The vast survey of literature showed that *Ocimum sanctum* has a broad spectrum of pharmacological activities. It has an esteemed status in herbs with diverse biological potentials and has a great scope for further new area of investigations. Traditionally crude extracts of various parts of plant have been used for their analgesic, antiasthmatic, antistress, antihyperlipidemic and antibacterial properties. Future research on sacred basil should be emphasized for control of various diseases especially it should be explore as a significant remedy regarding neuropsychological disorders for the welfare and service of mankind.

### ACKNOWLEDGEMENT

I would like to thank all of my colleagues who helped me during this work especially my Principal Prof. Dr. Kishu Tripathi and Mr. Kuldeep Kumar for their unforgettable contribution.

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