

A REVIEW

Therapeutic properties of *Ocimum sanctum* Linn. (Tulsi)

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SUMMARY :

Ocimum sanctum popularly known as Tulsi and called Holy Basil in English. It is ranked among the few wonder herbs, which has a versatile role in traditional systems of medicine. Several studies are being conducted regarding the efficacy of whole plant or its parts for treatment of different diseases and ailments. The active compound of the plant includes eugenol, ursolic acid, phenolic compounds, flavonoids etc. The health promoting and disease preventing properties such as antimicrobial, antioxidant, hepatoprotective, radio-protective, antistress, antiinflammatory, antidiabetic, antifertility, neuroprotective, antiulcer, cardio-protective, anticancer, anticarcinogenic, immunomodulatory and mosquito repellent properties have been described. These benefits have been investigated and verified by modern scientific research. The various aspects of therapeutic properties of *Ocimum sanctum* have been discussed in the present paper.

KEY WORDS : Anticarcinogenic, Antidiabetic, Eugenol, *Ocimum sanctum*, Therapeutic properties

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Plants are one of the most important source of medicines. Among them *Ocimum sanctum*, is called as Holy Basil in English a well known herbal medicinal plant, which is widely distributed in India. It belongs to Labiateae family. *Ocimum sanctum* is a fragrant bushy perennial growing up to 75-90 cm in height. Its leaves are nearly round and up to 5 cm long with margin being toothed all along. *Ocimum sanctum* leaves are aromatic because of the presence of a kind of scented oil.

Ocimum sanctum is worshipped in rituals for millennia for its health benefits. Its medicinal importance is described in several ancient scriptures like Rig Veda, Padma Purana and Tulsi Kavacham written between 5000 BC to 1200 AD. Chinese were the first to use plants as therapeutics before 4000-5000 BC. Properties of plants as a source of medicine were studied in detail in Ayurveda, which is considered as the foundation for all the medical sciences (Sirkar, 1989).

The chemical composition of *Ocimum sanctum* is highly complex, containing many nutrients and other biologically active

compounds. These constituents significantly vary with time, cultivation method and storage. The different parts of the herb such as leaves, flower, stem, root seed, etc are known to possess therapeutic potential and have been used by traditional medical practitioners. The leaves of *Ocimum sanctum* contain 0.7 per cent volatile oil comprising about 71 per cent eugenol and 20 per cent methyl eugenol. The oil also contains carvacrol and sesquiterpine hydrocarbon caryophyllene (Shah and Qadry, 1998). Fresh leaves and stem of *Ocimum sanctum* extract yielded some phenolic compounds (antioxidants) such as cirsilineol, circimaritin, isothymusin, apigenin and rosameric acid and appreciable quantities of eugenol (Yanpallewar *et al.*, 2004). Two flavonoids, *viz.*, orientin and vicenin from aqueous leaf extract of *Ocimum sanctum* have been isolated (Gupta and Prakash, 2002). Ursolic acid, apigenin, luteolin, apigenin-7-O-glucuronide, luteolin-7-O-glucuronide, orientin and molludistin have also been isolated from the leaf extract (Nair *et al.*, 1982). *Ocimum sanctum* also contains a number of sesquiterpenes and monoterpenes *viz.*, bornyl acetate, β -elemene, neral, α - and

β -pinenes, camphene, campesterol, cholesterol, stigmasterol and β -sitosterol. Considering the above facts it is thought that to worthwhile to explore the possibility of beneficial effects and to review its pharmacological action.

Therapeutic properties of *Ocimum sanctum*:

Ocimum sanctum possesses tremendous medicinal properties so much so that each and every part of the plant finds its use in medicinal formulations in one form or the other. The plant is pungent, bitter in taste, hot, stomachic, cholagogue, anthelmintic, alexiteric, useful in disease of heart and blood, leucoderma, strangury, asthma, vomiting, halitosis, lumbago pains, hiccup, painful eyes, purulent discharge of the ear, in burning sensation and snake bite (Kirtikar and Basu, 1965). Santals (a set of tribals) use the plant in fever, dropsy and anasarca hemiplegia, vomiting, constipation, cholera, cough, postnatal complaints, hemorrhage, septicaemia and dog bite (Jain and Tarafdar, 1970). *Ocimum sanctum* belongs to surasad group of drugs most of which are reputed vermifuges.

The leaves of *Ocimum sanctum* have expectorant properties and their juice is usefully applied in catarrhal bronchitis and also in throat and chest troubles. A decoction of leaves along with tea and milk has proved extremely useful in malaria. It is very helpful in curing cold, cough and indigestion. The dried leaves are powdered and mixed into a paste with mustard oil and used as a tooth-paste. It fights foul odours from the mouth and is useful in curing pyorrhea and other tooth troubles. The dried leaves are also employed as snuff in ozaena (offensive discharge from the nose). They are an effective means of dislodging maggots (Chopra *et al.*, 1956). Juice of fresh leaf tops and the slender roots are considered to be a good antidote against snake bite and scorpion sting. Fresh leaves paste with butter is applied on the face to remove blemishes and skin wrinkles. Ring worm rashes and other skin diseases can be cured by applying leaf juice or paste which is also used in ear ache and other minor infections of the ear, eyes and nose (Dymock *et al.*, 1980). It is also believed that five tender leaves along with five black pepper seeds taken empty stomach every morning strengthens weak heart and cures and prevents all types of fevers particularly malaria. Plant leaves are also used as condiment in salad and other foods. Few fresh leaves taken with tea or milk checks vomiting, acidity of the stomach and heat burn.

Aqueous decoction of whole plant lowers the blood sugar (glucose) level and is said to control diabetes mellitus (Nagarajan *et al.*, 1989). The fresh leaves and flower tops of *Ocimum sanctum* have been used as antispasmodic agent (as smooth muscle relaxant) (Sen, 1993; Rajeshwari, 1992). The seeds are mucilaginous and demulcent and are given in disorders of the genitor-urinary system (Rajeshwari, 1992). The leaves of *Ocimum sanctum* plant have also been shown to possess good anti-stress (adaptogenic), analgesic, anti-hyper

lipidemic, antioxidant potentials in experimental animals (Khanna and Bhatia, 2003; Rajeshwari, 1992; Bhargava and Singh, 1981; Ray, 1995; Sethi *et al.*, 2003; Sarkar *et al.*, 1994). Leaves and seeds of *Tulsi* plants have been reported to reduce blood and urinary uric acid level in albino rabbits and possess diuretic property (Sarkar *et al.*, 1990). Gastric ulceration and secretion are reported to be inhibited by *Ocimum sanctum* in albino rats (Sen, 1993; Mandal *et al.*, 1993).

Antimicrobial properties:

Aqueous extract, alcoholic extract and seed oil of *Tulsi* exhibits antimicrobial properties against enteric pathogens (Geeta *et al.*, 2001; Singh *et al.*, 2005). *Ocimum sanctum* exhibited significant antimicrobial activities against some of the clinical isolates and multi-drug resistant *Neisseria gonorrhoeae* (Shoken, *et al.*, 2008; Shoken *et al.*, 2005 and Mandal *et al.*, 2009).

Antibacterial properties:

Ocimum sanctum shows strong antibacterial activity against *Bacillus pumilus*, klebsiella, *Pseudomonas aeruginosa*, *E.coli* proteus, *Vibrio cholerae*. Higher content of linolenic acid in *Ocimum sanctum* fixed oil could contribute towards its antibacterial activity (Singh *et al.*, 2005). The ethanolic extracts from the leaves showed better activity against the β -lactamase producing methicillin resistant *Staphylococcus aureus* strains (Aqil *et al.*, 2005).

Antiviral properties:

Ocimum basilicum showed a strong antiviral activity against DNA viruses, RNA viruses, adenoviruses, hepatitis B virus and enterovirus (Chiang *et al.*, 2005). *Ocimum tenuiflorum* also has been reported to be having antiviral activity against Bovine herpes virus-1.

Antifungal properties:

Aqueous and acetone extracts of *Ocimum sanctum* were found to be sensitive to many plant fungi, *Alternaria tenuis*, *Helminthosporium* spp. and *Curvularia penniseli* (Sekhawat and Prasada, 1971)

Antistress properties:

Stress is a very common problem in today's competitive life. The production of more free radicals due to stress leads to adverse effects on various vital organs and tissues of the human body. *Ocimum sanctum* is an excellent rejuvenator, which has been known to help reduce stress, relax the mind and assist the body in improving memory. *Ocimum sanctum* has antihypoxic effect and it increases the survival time during anoxic stress (Rai *et al.*, 1975). Recent studies have shown that the leaves provide significant protection against stress (Reghunandana *et al.*, 1995). The ethanolic extract of *Ocimum*

sanctum at a dose of 20mg/kg, of body weight when given orally for seven days showed increased production of adrenaline, noradrenaline, monamine oxidase and caused decrease in dopamine and 5- hydroxytryptamine (serotonin) levels in mice following swimming and gravitation induced stresses (Singh *et al.*, 1991).

Anti-inflammatory properties:

Extracts of seeds from *Ocimum sanctum* have been studied for anti-inflammatory effects of carrageenan, leukotrine and arachidonic acid induced paw edema in rats. *Ocimum sanctum* seed oil showed maximum percentage inhibition of leukotrine induced paw edema (Singh *et al.*, 2008). *Ocimum sanctum* fixed oil has the capacity to block both the cyclo-oxygenase and lipoxygenase pathways of arachidonate metabolism and could be responsible for the anti-inflammatory activity of the oil (Singh, 1998; Singh and Majumdar, 1997; Singh *et al.*, 1996).

Antidiabetic properties:

Dry *Ocimum sanctum* leaf powder when fed at 1 per cent of total diet for 30 days to the rats with diabetes induced by alloxan, fasting blood sugar, uronic acid, total amino acids, total cholesterol, triglycerides, phospholipids and total lipids reduced significantly (Rai *et al.*, 1975 and Mandal *et al.*, 2009). Oral administration of *Ocimum sanctum* extract led to marked lowering of blood sugar in normal, glucose fed hyperglycemic and streptozotocin, induced diabetic rats (Chattopadhyay, 1993; Pandey and Madhuri, 2010).

Antioxidant properties:

Ocimum sanctum extract has significant ability to scavenge highly reactive free radicals (Mandal *et al.*, 1993; Pandey and Madhuri, 2010). 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 (Umadevi *et al.*, 2005). Eugenol is a major component of the volatile oil and other compounds also demonstrated good antioxidant activity (Kelm, 2000; Das and Vasudevan, 2006).

Hepatoprotective properties:

Ocimum sanctum offered liver protection against various experimentally induced damages (Mandal *et al.*, 2009). *Ocimum sanctum* leaf extract was found to be hepato-protective against hepatotoxic paracetamol by significant reduction of serum enzymes aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP) in rats and also showed marked reduction in fatty degeneration of liver on histopathological examination (Chattopadhyay *et al.*, 1992).

Radioprotective properties:

Water extract of *Ocimum sanctum* is more radio-protective

than the alcoholic extract. Optimum dose for water extract was found to be 10 mg/kg of body weight and optimum radio protection observed when the route of administration was intra-peritoneal. Increase in the doses, however, did not increase the level of radio-protection. This was observed when experimental mice were given water extract at a dose of 10 mg/kg body weight for consecutive 5 days before whole body γ -radiation (11 Gray) and the survival of mice were observed for period of 30 days (Umadevi and Gonasoundari, 1995; Mandal *et al.*, 2009). Radio protection efficacy of two flavonoids, orientin and vicenin, isolated from leaves of *Ocimum sanctum* (administered i.p. 10 mg/kg, bw/day to mice for five days) were compared with synthetic radio-protection aminothol 2 mercaptopropionyl-glycerine 'MPG' (20mg/kg, bw), WR- 2721 (150 mg/kg, bw). The experimental mice were subjected to whole body exposure to 2 Gy- γ -radiations for 30 minutes and bone marrow chromosomal aberrations were studied. It was observed that vicenin provided maximum protection from radiation induced chromosomal aberrations and MPG the least, while orientnin and WR-2721 provided almost similar effects (Umadevi *et al.*, 1998).

Anticancer properties:

Cancer has been a leading cause of death in the developing countries. With changing standard of living and food habits and also due to availability of curative treatment for many infectious diseases, cancer is surpassing other ailments as a principal cause of morbidity and mortality even in developing countries. The anticancer activity of *Ocimum sanctum* has been reported against human fibrosarcoma cell culture, where in alcoholic extract of this drug induced cytotoxicity @ 50 μ g/ml and above. Morphologically, the cells showed shrunken cytoplasm and condensed nuclei. The DNA was found to be fragmented on observation in agarose gel electrophoresis (Kathiresan *et al.*, 1999). Ethanolic extract of *Ocimum sanctum* mediated a significant reduction in tumor cell size and an increase in lifespan of mice having sarcoma 180 solid tumors (Nakamura *et al.*, 2004).

Anticarcinogenic properties:

Oral treatment of fresh leaf paste of *Ocimum sanctum* may have the ability to prevent the early events of DMBA induced buccal pouch carcinogenic (Karthikeyan *et al.*, 1999). Leaf extract of *Ocimum sanctum* blocks suppresses the events associated with chemical carcinogenesis by inhibiting metabolic activation of the carcinogen (Prashar *et al.*, 1998).

Immunomodulatory properties:

The seed oil can modulate both humoral and cell mediated immune responsiveness and their immunomodulatory effects may be mediated by GABA ergic pathways (Mukherjee *et al.*, 2005; Mediratta *et al.*, 2002; Das and Vasudevan, 2006). Steam

distilled extract of fresh leaves of *Ocimum sanctum* enhanced humoral immune responses in experimental rats. This was evident by enhanced count of anti-sheep red blood cell (anti-SRBC) haemagglutination titre and IgE antibody titre as measured by passive cutaneous anaphylaxis in rats. Antigen (egg albumin) induced histamine release from peritoneal cells of sensitized rats in *in-vitro* was significantly inhibited by fresh leaves extract of *Ocimum sanctum* (Mediratta *et al.*, 1998).

Antifertility properties:

Ursolic acid, one of the major constituents of the *Ocimum sanctum* leaves, has been suggested to possess antifertility effect in rats of both sexes and in male mice (Rajeshwari, 1992, Prakash and Gupta, 2005). The leaves of *Ocimum sanctum* have been shown to possess anti-implantation activity in experimental albino rats. Ursolic acid is responsible for its anti-sterility property (Ahmed *et al.*, 2002). In male rats benzene extract of *Ocimum sanctum* leaves has been suggested to reduce spermatogenesis by retarding the sertoli cell activity without affecting the germ cell (Reghunanadana *et al.*, 1995). Benzene extract of fresh *Ocimum sanctum* leaves in male rats showed decreased total sperm count, sperm motility and weight of testis (Seth *et al.*, 1981).

Neuroprotective properties:

The ethanolic extract of *Ocimum sanctum* was administered for ten days found to have ameliorative effects in axotomy induced peripheral neuropathy in rats, attenuated axonal degeneration and nociceptive threshold. It also reduced thiobarbituric acid reactive species (Muthuraman *et al.*, 2008).

Antiulcer properties:

Ocimum sanctum possesses potent antiulcerogenic as well as ulcer healing properties, which is due to its ability to reduce acid secretion and increase mucous secretion (Dharmani *et al.*, 2004). The fixed oil of *Ocimum sanctum* possesses

significant antiulcer activity against aspirin, indomethacin, alcohol (ethanol 50%), histamine, reserpine, serotonin or stress-induced ulcers in rats (Singh *et al.*, 2007). The lipoxygenase, inhibitory, histamine, antagonistic and antisecretory effects of the oil may be due to anti-ulcer activity (Singh and Majumdar, 1999).

Cardio-protective properties:

Eugenol and the essential oil have been found to reduce raised blood sugar, triglyceride and cholesterol levels and activities of LDH, GPT, GOT and alkaline phosphates in blood serum explaining the therapeutic potentials of *Ocimum sanctum* as cardio-protective agent (Nishijima *et al.*, 1999).

Mosquito repellent properties:

Mosquitocidal activity of *Ocimum sanctum* was investigated using its eugenol and triglyceride on fourth instars *Aedes aegypti* larvae (Kelm and Nair, 1998). Mosquitocidal efficacy of essential oil of *Ocimum sanctum* against adult mosquitoes of different species viz., *Anopheles stephensi*, *Aedes aegypti*, *Culex quinquefasciatus* were investigated and 100 per cent mortality observed in *A. stephensi*, *A. aegypti* at a dose of 0.003 ml/43.0 cm². However, mortality of *C. quinquefasciatus* was observed at a higher dose (0.01ml/43.0 cm²) (Bhatnagar *et al.*, 1993).

Conclusion:

Ocimum sanctum is known as the incomparable one, the mother medicine of nature and the queen of herbs due to its greater medicinal value. The health promoting, disease preventing and life prolonging properties of *Ocimum sanctum* have been described and these benefits have been investigated and verified by modern scientific researchers. However, much more studies are required to explore other potential benefits from this plant.

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