

Medicinal properties of tulsi (*Ocimum sanctum* Linn.): A review

Minakshi Ananta Ninave^{1*}, Swati Sanjay Patil²

Department of Pharmacognosy Student, Prin KM Kundnani College of pharmacy, Mumbai University, Mumbai, Maharashtra, India

Assistant professor, Department of Pharmacognosy, Prin KM Kundnani College of Pharmacy, Mumbai University, Mumbai, Maharashtra, India

Abstract

In this review, *Ocimum sanctum* Linn. (Labiatae) is studied. Medicinal properties are mainly present in stem, leaves, roots, seeds, and even whole plant of tulsi. In India, commonly tulsi is called as “Queen of Herbs”. Tulsi belongs to labiateae family. Therapeutically, tulsi not only used in Ayurvedic medicines but also in siddha and unani medicines. The medicinal properties of tulsi includes antifertility, anticancer, antidiabetic, anti-ageing, immunomodulatory, antimicrobial, cardioprotective, adaptogenic, antifungal, hepatoprotective, analgesic and antimalarial activities.

Active constituents of tulsi is eugenol, chemically which is (1-hydroxy-2- methoxy -4-allybenzene), is responsible for most of therapeutic actions of tulsi.

Keywords: tulsi, holy basil, *ocimum sanctum* linn, chemical constituents, medicinal properties, eugenol

Introduction

Plants are important source of medicines. Various *Ocimum* species are *Ocimum sanctum* Linn. (Tulsi), *O. gratissimum* (Ram tulsi), *O. canum* Sims (Dulal tulsi), *O. basilicum* linn. (Ban tulsi), *O. kilim and scharicum* Guerke (Camphor basil), *O. americanum* linn. (Hoary tulsi) and *O. micranthum* Willd. Among them *O. scantum* is mainly responsible for therapeutic activity ^[1]. *O. scantum* is an annual plant. It is 30 – 60 cm tall, erect, much branched with purplish stem and branches, green leaves which are simple, opposite and aromatic in nature. Leaves are oblong, with upto 5cm long ^[2]. Flowers are purple in color, small and racemes and seeds are red in color ^[2]. This plant is found throughout India from the Himalayas. There are two types, Vanya (Wild) and Gramya (grown in homes) ^[3]. This plant is used in treatment of cough, cold, malaria, dengue, bronchitis, influenza, asthma, sore throat, skin disorders, etc ^[4]. (Figure 1)



Fig 1: *Ocimum Sanctum* Linn. (Tulsi)

Botanical Description

Ocimum sanctum Linn. Is also known as Holy basil or sacred basil. This plant is commonly known as Tulsi which is derived from Sanskrit means “the incomparable one”. It belongs to the family Lamiaceae or Labiateae. This plant Mostly found in South Asia and in throughout India ^[5].

Scientific Classification

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Lamiales

Family: Labiateae or Lamiaceae

Genus: *Ocimum*

Species: *Sanctum*

Synonyms

Holy basil, sacred basil, Manjari, Krishna tulsi, Vishnu priya and Brinda.

Morphology

The holy basil is an annual herb and the habitat is very different with related species of tulsi having variable habitats. The leaves are generally simple, obtuse, petiolate or sessile, with dented margin. The flowers in *Ocimum* are elongate raceme in purple colored and thyrse containing opposite 1, 3- flowered chymes. The calyx is funnel shaped, which may be straight or slightly curved. The corolla is mainly straight or can be slightly curved from downwards. The androecium of flower always have four stamens. The gynoecium or ovary is divided into 4 parts in all of tulsi species ^[6]. (Figure 2)



Fig 2: Different Types of Tulsi

Chemical Constituents

Ocimum sanctum Linn. Contains large number of phytoconstituents. Leaves contain 0.7% of volatile oil. Volatile oil contains 20% methyl eugenol and 70% eugenol (figure 3). The presence and concentration of phytoconstituents may vary due to different growing, harvesting, processing and storage conditions. The odour is due to volatile oil which is mainly present in leaves of tulsi. [7] The carvacrol, ursolic acid (figure 4), limatrol, linalool, caryophyllene (figure 5) or other constituents also present in volatile oil. Stem and fresh leaves contain phenolic compounds such as isothymusin, cirsilincol, apigenin (figure 6), cirsimaritin, rosmarinic acid (figure 7) and eugenol. Some flavonoids such as, vicenin, orientin, luteolin and ursolic acid are extracted from aqueous leaf extract [8].

It also contains some sesquiterpenes and monoterpenes, B – elemene, bornyl acetate, a- and b- pinenes, neral, camphene, cholesterol, b- sitosterol, stigmasterol, campesterol, etc [9].

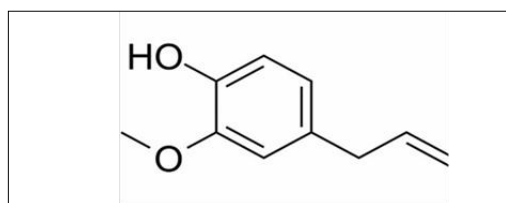


Fig 3: Eugenol (1-Hydroxy-2-Methoxy-4-Allyl Benzene)

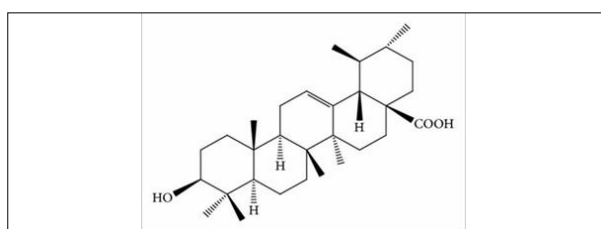


Fig 4: ursolic acid (2,3,4,5,6,6a,7,8a,10,11,12,13,14b-tetradecahydro-1h-picen-4a-carboxylic acid)

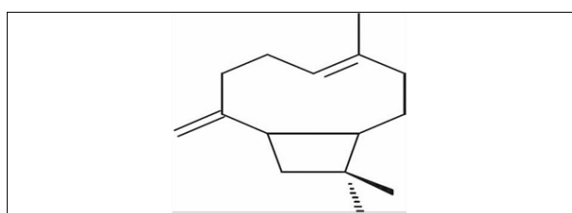


Fig 5: caryophyllene (4, 11, 11-trimethyl-1-8methyl bicyclo [7.2.0] undec-4-ene)

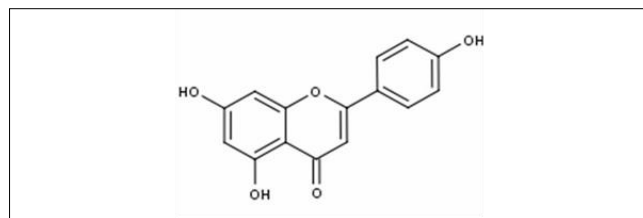


Fig 6: Apigenin (5, 7-dihydroxy-2-(4-hydroxyphenyl)-4h-1-benzopyran-4-one)

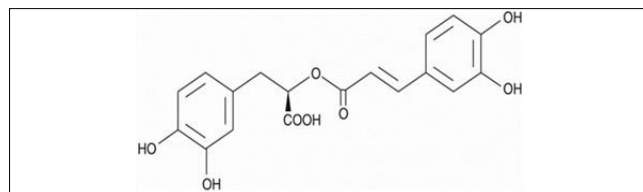


Fig 7: Rosmarinic acid ((2r)-2-[[2e)-3-(3,4-dihydroxyphenyl)-1-oxo-2-propenyl]oxy]-3-(3,4-dihydroxyphenyl)propanoic acid)

Medicinal Properties

Scientific research have been carried out on various Activities of tulsi and evaluated. Some of the therapeutic properties is described. (Table 1)

Table 1: Medicinal activity of various parts of Tulsi

Sr No.	Medicinal activity	Plant part used	Extracts
1	Anticancer activity	Leaves	Alcoholic extract
2	Antimalarial activity	Leaves	Aqueous extract
3	Antidiabetic activity	Whole plant	Aqueous decoction
4	Immunomodulatory activity	Seeds/ whole plant	Seed oil/ aqueous extract
5	Antihypertensive/ cardio protective activity	Seeds/ whole plant	Fixed oil
6	Antimicrobial activity	Leaves	Aqueous extract/ fixed oil
7	Antioxidant activity	Whole plant	Alcoholic extract
8	CNS depressant activity	Leaves	Alcoholic extract
9	Anti-inflammatory activity	Whole plant	Alcoholic extract/ fixed oil
10	Antipyretic activity	Seeds	Fixed oil
11	Hepato Protective activity	Leaves	Hydroalcoholic extract
12	Antifertility activity	Leaves	Benzene extract
13	Antulcer activity	seeds	Fixed oil
14	Antiarthritic activity	seeds	Fixed oil
15	Anti-asthmatic activity	Leaves	Hydroethanolic extract
16	Antifungal activity	Leaves	Essential oil
17	Memory enhancer activity	Leaves	Alcoholic extract
18	Antitussive activity	Leaves/ stem	Methanolic/ Aqueous extract
19	Anticonvulsant activity	Stem/ Leaves/ Stem callus	Alcoholic/ Chloroform extract
20	Chemo Preventive extract	Seeds	Fixed oil

Anticancer activity: The alcoholic extract of leaves of *O. sanctum* have effect on carcinogen metabolizing enzyme such as cytochrome P5, cytochrome P450, Glutathione s-transferase (GST), Aryl hydrocarbon hydroxylase [10]. The alcoholic extract induces toxicity on human fibro sarcoma cell, which has reported at 50 ug/ml dose. The cytoplasm of cell get shrunk and nuclei got condensed [11]. Topically used fresh leaf extract in 7, 12- dimethyl lbenzanthracene

(DMBA) induces (0.5%) papillomagenesis which ultimately reduces tumor, this has been studied in mice. Tulsi is effective in various cancers, such as skin cancer, oral cancer, lung cancer, breast cancer, gastric cancer and liver cancer [12].

Antimalarial activity: Boiled leaves of tulsi with tea act as a preventive measure against malaria and degue fever, which is mainly associated with cough and cold. The preparation including *Ocimum sanctum*, *Piper nigrum* and *Curcuma longa* have been used to relieve clinical symptoms of malaria. Tulsi is main constituent in Ayurvedic expectorants and cough syrup [13].

Antidiabetic activity: Tulsi extract when administered orally, lowers elevated blood sugar, this has been studied on streptozotocin induced rats. [14] Reduction in serum lipid profile, fasting blood sugar and lipid peroxidation production also been found. A randomized study which is placebo controlled showed significant decrease in postprandial and fasting blood sugar level by 7.3% and 17.6% respectively [15]. The five partition fractions and ethanol extract of tulsi leaves together shows effect on insulin secretion, which is evaluated for its mechanism of action, which is that, tulsi leaf extract stimulate insulin secretion from isolated islets, perfused pancreas and colonic pancreatic-cells. [16]

Immunomodulatory and adaptogenic activity: Study carried out by Jeba *et al.* in 2011 showed that, aqueous extract of tulsi leaves at 100, 200 mg/kg/day dose orally in rats, enhances the production of RBC, WBC, haemoglobin and also increases the production of antibodies [17]. The seed oil of *Ocimum sanctum* can enhance both humoral and cell-mediated immune responsiveness [18] which may be mediated by GABAergic pathways [19].

Antihypertensive and Cardioprotective activity: Cerebral hypoperfusion and transient cerebral ischemia have been prevented by *Ocimum sanctum* [20]. The linoleic and linolenic acids which are essential fatty acids present in *Ocimum sanctum* fixed oil produces PGE1 and PGE3 prostaglandins and inhibit the formation of PGE2 prostaglandins which shows hypotensive effect due to its peripheral vasodilation action [21].

Antimicrobial activity: Aqueous extract showed to inhibit growth of *Escherichia coli*, *Staphylococcus aureus*, *klebsiella* and *proteus*. Alcoholic extract showed to inhibit growth of *Vibrio cholera* [22]. The alcoholic extract of *Ocimum sanctum* found to be effective against multidrug-resistant strains of *S. aureus* [23] Fixed oil of *Ocimum sanctum* containing linoleic acid contribute towards its antibacterial activity against *Pseudomonas auregenosa*, *Bacillus Pumilus* and *S. aureus*. [24]

Anti-oxidant activity: *Ocimum sanctum* scavenges the highly reactive free radicals [20]. Eugenol which is major compound of volatile oil, shows good anti-oxidant activity. Flavonoids also Posses anti-oxidant activity mainly vicenin and orientin. Phenolic compounds *viz.* isothymusin, rosmarinic acid, cirsilineol, apigenin present in extract of tulsi leaves also Posses anti-oxidant activity [8]. B- Carotene and tocopherol present in basil is also responsible for anti-

oxidative activity [25]. Central Nervous System (CNS) depressant activity: Time of lost reflex in mice due to Penobarbital (40mg/kg, ip) can be prolonged by *Ocimum sanctum* and thus decrease in recovery time and severity of electroshock and pentelenetetrazole induced convulsions. *Ocimum sanctum* also decreased apomorphine induced fighting time. At high doses, extract of *Ocimum sanctum* increased swimming time responsible for a CNS stimulant or antistress activity. This effect was comparable to another antidepressant drug that is desipramine [26]. Fixed oil of *Ocimum sanctum* in dose of 2-3 ml/kg, ip, also shows increase in phenobarbital- induced sleeping time in rats [21].

Anti-inflammatory activity: Methanolic extract of *Ocimum sanctum* (500 mg/kg) and its aqueous suspension proved to show anti-inflammatory activity in acute and chronic inflammation in rats. Therefore it is responsible for anti-inflammatory activities against PGE2 and leukotriens induced paw edema in rats [27]. Linolenic acid and fixed oil of tulsi blocks lipoxygenase and cyloxygenase pathways of arachidonic acid metabolism which is responsible for anti-inflammatory activity [28].

Antipyretic activity: The seeds of *Ocimum sanctum* fixed oil was evaluated for antipyretic activity testing against typhoid-paratyphoid A/B vaccine-induced pyrexia in rats. The intraperitoneal administration of fixed oil reduced the febrile response which shows its antipyretic activity [29].

Hepatoprotective activity: Hydroethanolic extract of *Ocimum sanctum* leaves when administered orally at dose of 200 mg/kg in male albino rats, it provides protection against liver injury induced by paracetamol [30].

Antifertility activity: Albino rats when treated with benzene extract of *Ocimum sanctum* leaves (250mg/kg body weight) it leads to decrease in the total sperm count and sperm motility. This result is due to androgen deprivation which is because of anti-androgenic property of *O. sanctum* leaves. The other effects are increase in sperm testosterone level and significant reduction in the level of FSH and LH and sperm count [31].

Antiulcer activity: The seeds of *Ocimum sanctum* fixed oil when administered intraperitoneally shows antiulcer activity against indomethacin, aspirin, ethanol, reserpine, histamine, serotonin or stress induced ulcers in rats [39]. The fixed oil Posses antiulcer activity is due to histamine antagonistic, lipoxygenase inhibitory and antisecretory effects of *Ocimum sanctum* leaves [32].

Antiarthritic activity: Freund's adjuvant arthritis, turpentine oil-induced joint edema and formaldehyde-induced arthritis in rats are screened for antiarthritic activity for seeds of *Ocimum sanctum* fixed oil. The *O. sanctum* fixed oil shows good antiarthritic activity for above three models [33].

Antiasthmatic Activity: Dried and fresh leaves, 50% Hydroethanol and volatile and fixed oil of *Ocimum sanctum* were evaluated against acetylcholine and histamine induced preconvulsive dyspnea (PCD) in guinea pigs. Volatile oil from fresh leaves and 50% ethanol extract from fresh leaves

shows significant result against PCD except 50% ethanol extracts from dried leaves did not show significant result against PCD [34].

Antifungal activity: Essential oil of *Ocimum sanctum* leaves contains linalool and methyl chaviol which showed antifungal activity against candida fungi including its azole resistant strain [35]. Methanolic and aqueous extracts of *O. sanctum* showed antifungal activity against *T. rubrum* which is dermatophytic fungus. Methanolic extract showed less result as compared to aqueous extract of *O. sanctum* [36].

Memory enhancer activity: The alcoholic extract of dried whole plant of *Ocimum sanctum* enhances the amnesic effect of scopolamine in dose of 0.4 mg/kg and ageing induced memory deficit in mice. *O. sanctum* extract increased acetylcholinesterase inhibition and step-down latency. Therefore, *O. sanctum* can be used in treatment of dementia and Alzheimer's disease [37].

Antitussive activity: Methanolic and aqueous extracts of *Ocimum sanctum* at the doses of 1.55g and 0.875g/kg body weight was studied for antitussive activity. The cough was induced by exposure to aerosol of citric acid (7.5% w/w). The test results showed that aqueous extracts showed higher antitussive activity than the methanolic extract [38].

Anticonvulsant activity: Leaf, stem and stem callus extracts of *Ocimum sanctum* were tested for anticonvulsant activity against phenytoin (standard drug) using maximal electroshock model (MES). Tonic convulsions induced by transcorneal electroshock was prevented by ethanol and chloroform extracts of leaf, stem and stem calli [39].

Chemopreventive activity: The seed oil of *Ocimum sanctum* was tested for chemopreventive activity against 20-methylcholanthrene induced fibrosarcoma tumors in thigh region of Swiss albino mice. Maximal tolerated dose of 100mg/kg body weight is supplemented along with oil which showed reduction tumor incident and tumor volume [40].

Conclusion

Tulsi has been used from many years in ayurvedic medicines. It has been also used for household purposes for its wide range of therapeutic uses. This herb is also used to increase the immunity of body. But, still there is need for more clinical trials to support its wide range of therapeutic properties.

References

1. Prakash P and Gupta N, Therapeutic uses of *Ocimum sanctum* Linn (Tulsi) with a note on eugenol and its pharmacological actions: a short review, *Indian J Physiol Pharmacol*,2005;49(2):125-131.
2. Kumar PK. Pharmacological actions of *Ocimum sanctum*. Review article *Int. J. Advnc. Pharm. Bio. Chem*,2012;1(3):406-414.
3. Das SK, Vasudevan DM. Tulsi: The Indian Holy power Plant. *Natural Product Radiance*,2006;5:279-283.
4. Joseph B. Ethan Pharmacological and Phytochemical aspects of *Ocimum sanctum* Linn. The elixir of life. *Brit. J Pharma. Res*,2013;3(2):273-292.
5. Renu K, Milind P. Therapeutic Potential and Phyto pharmacology of tulsi: Review article, *Int. J. of Pharm. And Life Sci*,2012;3:1858-1867.
6. Gayatri N, RC M, RK S. Taxonomic Distribution, Medicinal Properties and Drug Development Potentiality of *Ocimum sanctum* (Tulsi): Review article; *Drug Invention Today*, 2011, 3(11), ISSN: 0975-7619, pg. 95-113.
7. Mondal S, Mirdha BR, Mahapatra SC. The science behind sacredness of Tulsi (*Ocimum sanctum* Linn.). *Indian J Physiol Pharmacol*,2009;53:291-306.
8. Gupta SK, Prakash J, Shrivastava S. Validation of traditional claim of Tulsi, *Ocimum sanctum* Linn. as medicinal plant. *Indian J Exp Biol*,2002;40:765-773.
9. Jaggi RK, Madaan R, Singh B. Anticonvulsant potential of holy basil, *Ocimum sanctum* Linn., and its cultures. *Indian J Exp Biol* 4003; 41:1329-1333.
10. Pandey Govind, Madhuri S. Medicinal plants: Better remedy for neoplasm. *Indian Drug*,2006;43(11):869-874.
11. Kathiresan K, Gunasekan P, Rammurthy N, Govindswami S. Anticancer activity of *Ocimum sanctum*. *Pharmaceutical Biology*,1999;37(4):285-290.
12. Prashar R, Kumar A, Banerjee S, Rao AR. Chemopreventive action by an extract from *Ocimum sanctum* on mouse skin papillomagenesis and its enhancement of skin glutathione- S-transferase activity and acid soluble sulfhydryl level. *Anticancer Drugs*,1994;5:567-572.
13. Pandey BP, Anita. In: *Economic Botany* (Published by Chand and Company Ltd., Ramnagar, New Delhi), 1990, 294.
14. Chattopadhyay RR. Hypoglycemic effects of *Ocimum sanctum* leaf extract in normal and streptozotocin induced rats. *Indian J Exp Biol*,1986;24:302.
15. Agrawal P, Rai V, Singh RB. Randomized Placebo controlled, single blind trial of holy basil leaves in patients with noninsulin dependent diabetes mellitus. *Int J Cli Pharmacol Ther*,1996;34:406.
16. Hannan JMA, Marenah L, Ali L, Rokeya B, Flatt PR, Abdel-Wahab YHA. *Ocimum sanctum* leaf extracts stimulate insulin secretions from perfused pancreas, isolated islets and clonal pancreatic-cells. *Journal of Endocrinology*,2006;189:127-136.
17. Jeba CR, Vaidyanathan R, Rameshkumar G. Immunomodulatory activity of aqueous extracts of *Ocimum sanctum* in rat. *International Journal on Pharmaceutical and Biomedical Research*,2011;2:33-38.
18. Mukherjee R, Dash PK, Ram GC. Immunotherapeutic potential of *Ocimum sanctum* L. in bovine subclinical mastitis, *Res Vet Sci*,2005;79(1):21-28.
19. Mediratta PK, Sharma KK, Singh S, Evaluation of Immunomodulatory potential of *Ocimum Sanctum* seed oil and its possible mechanism of action, *J Ethnopharmacol*,2002;80(1):15-20.
20. Klem MA, Nair MG, Strasburg GM, DeWitt DL. Antioxidant and cyclooxygenase inhibitory phenolic compounds from *Ocimum sanctum* Linn. *Phytomedicine*,2000;7(1):7-13.

21. Singh S, Rehan HMS, Majumdar DK. Effect of *Ocimum scantum* fixed oil on blood pressure, blood clotting time and phenobarbitone-induced sleeping time. *J Ethnopharmacol*,2001;78:139.
22. Geeta, Vasudevan DM, Kedlaya R, Deepa S, Ballal M. Activity of *Ocimum sanctum* (the traditional Indian medicinal plant) against the enteric pathogens, *Indian J Med Sci*,2001;55(8):434-438:472.
23. Auil F, Khan MS, Owais M, Ahmad I. Effect of certain bioactive plant extracts on clinical isolates of beta-lactamase producing methicillin resistant *Staphylococcus aureus*. *J Basic Microbial*,2005;45(2):106-114.
24. Singh S, Malhotra M, Majumdar DK. Antibacterial activity of *Ocimum sanctum* L. fixed oil. *Indian J Exp Biol*,2005;43:835.
25. Chen B, Chuang J, Lin J, Chiu C. Qualification of provitamin A compounds in Chinese vegetables by high-performance liquid chromatography. *J. Food Prot*, 1993;56:51-54.
26. Sakina MR, Dandiya PC, Hamdard HE, Hameed A. Preliminary psychopharmacological evaluation of *Ocimum sanctum* leaf extract. *J Ethnopharmacol*,1990;28:143.
27. Pandey G. Pharmacological activities of *Ocimum sanctum* (Tulsi): A review. *Int J. Maxi Res*,2010;5(1):61-66.
28. Singh S, Majumdar DK. Evaluation of anti-inflammatory activity of fatty acids of *Ocimum sanctum* fixed oil. *Indian J Exp Biol*,1997;35:380-383.
29. Singh S, Taneja M, Majumdar DK. Biological Activities of *Ocimum sanctum* L. fixed oil- An overview. *Indian J Exp Biol*,2007;45:403-412.
30. Chattopadhyay RR, Sarkar SK, Ganguly S, Medda C, Basu TK. Hepatoprotective activity of *O. scantum* leaf extract against paracetamol induced hepatic damage in rats. *Indian J Pharmacol*,1992;24:163.
31. Kadian R. Therapeutic Potential and Phyto pharmacology of tulsi. *Int.mJ Pharm. and Life Sci*.2012;3(7):1858-1867.
32. Singh S, Majumdar DK. Evaluation of the gastric antiulcer activity of fixed oil- *Ocimum sanctum* (Holy basil). *J Ethnopharmacol*,1999;65:13-19.
33. Singh S, Majumdar DK. Effect of fixed oil of *scimum sanctum* against experimentally induced arthritis and joint edema in laboratory animals. *Int J. Pharmacol*,1996;34:218.
34. Singh S, Aggrawal SS. Antiasthmatic and Antiinflammatory activity of *Ocimum sanctum*. *Int J of Pharmacognosy*,1991;29:306-310.
35. Gonasoundari A, Uma Devi P, Rao BSS. Enhancement of bone marrow radioprotection and reduction of WR-2721 toxicity by *Ocimum sanctum*. *Mutat Res*,1998;397: 303.
36. Bala kumar S. Anti-fungal activity of *Ocimum sanctum* Linn. (Lamiaceae) on clinically isolated dermatophytic fungi. *Asian. Paci J. Trop. Med*, 2011, 654-657.
37. Joshi H, Parle M. Cholinergic basis of memory improving effect of *Ocimum tenuiflorum* Linn. Nadgi P. D. and Laxmi S. Study of Anti-tussive Activity of *Ocimum sanctum* Linn. In Guinea Pigs. *Ind J Physiol Pharmacol*,2005;49:243-245.
38. Nadgi PD, Laxmi S. Study of Anti-tussive Activity of *Ocimum sanctum* Linn. In Guinea Pigs. *Ind J Physiol Pharmacol*.2005;49:243-245.
39. Jaggi RK, Madaan R, Singh B. Anticonvulsant potential of Holy basil, *Ocimum sanctum* Linn. and its cultures. *Ind J of Experimental biology*,2003;41:1329-1333.
40. Prakash J, Gupta SK. Chemopreventive activity of *Ocimum sanctum* seed oil, *Journal of Ethno pharmacology*,2000;72:29-34.