



A review on phytochemicals present in *Ocimum sanctum* and its medicinal property

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Abstract

The plant of *Ocimum sanctum* generally known as “*Tulsi* or ‘*Holy Basil*”. It belongs to *Lamiaceae* family. It is an erect, much branched, fragrant and erected plant attaining a height of about 20-50 cm. Different parts of the plant are used in Ayurveda and Siddha. Scientific investigations have shown that *O. sanctum* has a plethora of biological and pharmacological activities. The presence of an impressive number of phyto-constituents in *O. sanctum* could explain its exceptional beneficial effects such as medicine for prevention and cure of many illnesses like cough, influenza, common cold, headache, fever, colic pain, bronchitis, asthma, hepatic diseases, fatigue, skin diseases, arthritis, digestive disorders, cancer. From the ancient history *Tulsi* is used to treat several types of diseases. It means there is huge use of *Tulsi* from ancient time till now. Now scientifically it is used as the treatments of cancer cell in human body. Extensive studies, experimental and clinical prove that *Tulsi* possess anti-stress, antioxidant, immunomodulator and anti-radiation properties which also may help it to play major role in prevention and treatment of cancer.

Keywords: *Ocimum sanctum*, *Tulsi*, chemical constituents, medicinal properties

Introduction

Plants are the richest resource of drugs of traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs. The use of plants and plant products as medicines could be traced as far back as the beginning of human civilization. The earliest mention of medicinal use of plants in Hindu culture is found in “*Rigveda*”, which is said to have been written between 4500 - 1600 B.C. and is supposed to be the oldest repository of human knowledge. It is Ayurveda, the foundation of medicinal science of Hindu culture, in its eight divisions deals with specific properties of drugs and various aspects of science of life and the art of healing.

Medicinal plants are a source of great economic value all over the world. Nature has bestowed on us a very rich botanical wealth and a large number of diverse types of plants grow in different parts of the country. Nepal is rich in all the 3 levels of biodiversity, namely species diversity, genetic diversity and habitat diversity. In Nepal thousands of species are known to have medicinal value and the use of different parts of several medicinal plants to cure specific ailments has been in vogue since ancient times. Herbal medicine is still the mainstay of about 75 - 80% of the whole population, and the major part of traditional therapy involves the use of plant extract and their active constituents. Among the 7,000 species of medicinal plants recognized all over the world, more than 900 types of precious medicinal plants are said to be found in Nepal. Unfortunately, only few of them are used for their medicinal value. Our approach involved to explore the antibacterial activity of four medicinal plants and study their antimicrobial constituents.

Ayurveda is a system of traditional Hindu medicine which is native to India and is renowned as one of the major systems of alternative and complementary medicine. According to Hindu mythology, Dhanvantari, the physician of the God's,

is attributed with the origin of ayurvedic medicine. Ayurveda traces its origin to the Vedas particularly Atharvaveda and it stresses the use of indigenous plant-based medicines for the treatment of diseases. (Patwardhan, Warud 2005) [5]

Tulsi “Queen of herbs” is described as sacred and medicinal plant in ancient literature. It is an important symbol of the Hindu religious tradition. The name *Tulsi* is derived from „Sanskrit”, which means “matchless one” (Ghosh 1995) [2]. Its other name, *Vishnu Priya* means the one that pleases Lord *Vishnu*. This plant belongs to the family *Labiatae*, characterized by 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 (Anonymous. 1991) [3].

1. Medicinal Properties

Antispasmodic, appetizer, carminative, galactagogue, stomachic. *Basil* is antispasmodic, appetizer, carminative, galactagogue, and stomachic. It is used for stomach cramps, gastric catarrh, vomiting, intestinal catarrh, constipation, and enteritis. It had been sometimes used for whooping cough as an antispasmodic.

1. *Tulsi* has antioxidant properties and reduces blood glucose levels. Thus, it is useful for diabetics.
2. *Tulsi* reduces total cholesterol levels. Thus, it is useful for heart disease patients.
3. *Tulsi* reduces blood pressure.
4. *Tulsi* is also used to prepare herbal tea. It helps in building up stamina.
5. It has been used for gastric disorders, cough, common colds, malaria, and headaches.
6. It is used as mouth wash for reducing tooth ache
7. *Tulsi* oil shows larvicidal activity against malarial larva.
8. It has immuno-modulatory properties.

9. It contains phyto-chemicals which provide all these beneficial effects.
10. Many herbal cosmetics contain tulsi. It is also used in skin ointments due to its anti-bacterial properties. Oil extracted from Karpoora Tulsi is used in these preparations.
11. Tulsi acts as insect repellent. So, it is used to store grains.
12. Recent research shows that tulsi does have analgesic (pain killer) properties similar to COX 2 inhibitor drugs.
13. Ursolic acid, a chemical in tulsi may have a role as antifertility (contraceptive) agent in future.
14. It has antiviral, antibacterial, antitubercular, antifungal, antimalarial properties

Analgesic Activity

Singh *et al.*, in 1995 [4] 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 it 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. (Singh S. and Majumdar K. D. (1995) [4].

Antiulcer Activity

The aqueous extract of *Ocimum sanctum* (100mg /kg a 200 mg/kg orally) exhibited significant protection against ethanol induced gastric ulceration in Wistar rats. OS exhibits antiulcer activity by enhancing antioxidant potential of gastric mucosa there by reducing mucosal damage (Ghangale, Mahale 2009) [5].

Anticancer activity

In Ayurveda, various plants are used as a potential source of anticancer and antitumor properties. It has been found that 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, Ishida 2004] [6]. Similar results were also obtained by others where leaf extract administered orally (200 mg/kg, p.o.) resulted in significant reduction in tumor volume, increase in average body weight, and survival rate of mice [Monga, Sharma 2011] [7]. *Ocimum* has the ability to protect the DNA of the body from dangerous radiations [Panda S and Kar, 1998] [8].

Antidiabetic activity

O. sanctum has been reported to possess very good anti diabetic properties. The anti-diabetic activity of hydroalcoholic extract of *O. tenuiflorum* against streptozotocin and nicotimanide induced diabetes in rats was found to be significant at the dose levels of 250 and 500 mg/kg body weight and this effect was comparable with

glibenclamide [Parasuraman, Balamurugan 2015] [9]. Hyperglycaemia was shown to be reduced in alloxan diabetic rats when administered ethanol extract of *O. sanctum* in both acute and long-term feeding studies [Vats, Grover 2002] [10]. In another study by J M A Hannan *et al.* prominent insulin-secretory effects were noted in the rat pancreas perfused with the ethanol extract and three partition (ethyl acetate, butanol and aqueous) fractions of *O. sanctum*. Similar effects were found in acute insulin-release studies using isolated rat islets [Hanna, Marenah 2006] [11]

Antilipidemic Activity

Hyperlipidaemia, atherosclerosis and related diseases are becoming a major health problem now days. Aqueous extract of *O. basilicum* reduces the level of total cholesterol, triglycerides and LDL-cholesterol levels in acute hyperlipidaemia induced by triton WR-1339 in rats. In a study conducted on rabbits a diet supplemented with 1-2 % fresh leaves of *Tulsi* for 28 days lowered the total lipid.

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.

Anti-Fertility Activity

The benzene and petroleum ether extracts of leaves of Tulsi have been reported to produce 80% and 60% antifertility activity respectively in female rats [Nagarajun S *et al.*, 1989] [12]. In Kerala the local women as well as the Ayurvedic physicians have been reported to use the leaves of Tulsi for antifertility effect [Batta and Santhakumari 1971] [13]. One of the major constituents of the Tulsi leaves is ursolic acid and it has been reported that it possesses antifertility effect. This effect has been attributed to its anti-estrogenic activity which may be responsible for arrest of spermatogenesis in males and due to inhibitory effect on implantation of 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 [Prakash & Gupta, 2005] [14].

2. Phytochemicals Found in Tulsi

Fresh leaves and stem of *Ocimum sanctum* extract yielded some phenolic compounds (antioxidants) such as cirsilinoleol, circimaritin, isothymusin, apigenin and rosameric acid, and appreciable quantities of eugenol. The leaves of *Ocimum sanctum* contain 0.7% volatile oil comprising about 71% eugenol and 20% methyl eugenol. The oil also contains carvacrol and sesquiterpine hydrocarbon caryophyllene. Two flavonoids orientin and andvicenin from aqueous leaf extract of *Ocimum sanctum* have been isolated.

Name of the identified compound	Molecular formula
Eugenol	$C_{10}H_{12}O_2$
Caryophyllene	$C_{15}H_{24}$
Cyclohexane, 1,2,4-triethenyl-	$C_{12}H_{18}$
Pentanedinitrile, 2-methyl-	$C_5H_8N_2$
10-Heptadecen-8-ynoic acid, methyl ester, (E)-	$C_{18}H_{30}O_2$
Benzene methanamine, N, N-a, 4-tetramethyl-	$C_{11}H_{17}N$
Cyclopentane, cyclopropylidene-	C_8H_{12}
Z, Z-4,16-Octadecadien-1-ol acetate	$C_{20}H_{36}O_2$
3',8,8'-trimethoxy-3-piperidyl-2,2'-binaphthalene1,1',4,4'-tetrone	$C_{28}H_{25}NO_7$
Octadecane, 1,1-dimethoxy-	$C_{20}H_{42}O_2$

Fig 1

3. Effect of Phytochemical on Cancer

Anticancer property of *Ocimum sanctum*

The experimental studies carried out on biological models using OS extract on fibrosarcoma cells in culture have demonstrated that *Ocimum sanctum* exhibits anticancer activity. [Karthikeyan K et. al,1999] [26] The fresh leaf of the *Ocimum sanctum* has been shown to enhance the immunity and also to possess anti carcinogenic properties in experimental animals. Besides above, *Ocimum sanctum* has also been demonstrated to exhibit rejuvenating properties anti-septic and anti-allergic effects. Tulsi has many beneficial properties with negligible toxicity, and is an ideal antistress/adaptogenic agent for the promotion of health and the prevention and treatment of disease. Life without health was well described by Herophilus in 300 BC. Methanolic extract of *Ocimum sanctum* has been shown to possess cancer preventive activities through reduction of excess amount of nitric oxide. Tulsi has been found to decrease the incidence of benzo (a) pyrene-induced neoplasia and 3-methyl di-methyl amino azobenzene, induced hematomas in experimental animals. [Aruna K & Sivaramkrishnan VM 1990] [15] Topical treatment with the ethanolic tulsi leaf extract has been found to produce significance reduction in the values of tumor incidence (Papillomas) in the skin of albino mice. [Prashar etl, 1994] [16] A similar activity was observed for eugenol, a flavonoid present in many plants, including Tulsi. Antimetastatic activity has also been observed in ethanol extract of OS through activation of antioxidative enzymes such as superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GSH-Px) in a concentration dependent manner. [Kim etal 2010] Kathirvel P and Ravi S [Kathirvel,etal, 2011] [18] conducted the studies to identify the chemical composition and *in vitro* anticancer activity of the essential oil from *Ocimum basilicum* Linn. The major constituents were found to be methyl cinnamate (70.1%), linalool (17.5%), β -elemene (2.6%) and camphor (1.52%). The results revealed that this plant may belong to the methyl cinnamate and linalool chemotype. [Govind et. al., 2006] Furthermore, the anticancer activity of OS has been reported against human fibrosarcoma cells culture. The results of the study demonstrated that morphologically, the cells showed shrunken cytoplasm and condensed nuclei and the DNA was found to be fragmented on observation in agarose gel electrophoresis. [Kathiresan, et. al., 1999] [23] Several studies have shown that OS possess prominent

anticancer activity. [Madhuri S, 2008] [24] The experimental study conducted on animal models have indicated that OS has capability to decrease the incidence of benzo(a)pyrene induced neoplasia of forestomach of mice and 3-methyl-4-dimethylaminoazobenzene induced hepatomas in rats. The alcoholic extract of the leaves of OS was shown to have an inhibitory effect on chemically induced skin papillomas in mice. [Devi PU, 2001] [25] Oral treatment of fresh leaves paste of Tulsi may have the ability to prevent the early events of 7, 12- Dimethylbenz (a) anthracene (DMBA) induced buccal pouch carcinogenesis. Leaf extract of OS has been found to block or suppress the events associated with chemical carcinogenesis which might be due to inhibition of metabolic activation of the carcinogen. [Prashar & Kumar1998] [28] The anticancer activity of OS was observed in Swiss albino mice bearing Ehrlich ascites carcinoma (EAC) and S 180 tumours. [Somkuwar 2003] [27] The ethanolic *O. sanctum* leaf extract has been found to inhibit 7, 12-dimethylbenz[a]anthracene (DMBA)-induced genotoxicity and oxidative stress by modulating xenobiotic metabolizing enzymes, reducing the extent of lipid and protein oxidation and up-regulating antioxidant defenses. [Manikandan, 2007] [21] Manikandan P *et al.* studied the combinatorial chemopreventive efficacy of *Azadirachta indica* (AI) and *Ocimum sanctum* (OS) against N-methyl-N'-nitro-N-nitrosoguanidine (MNNG)-induced gastric carcinogenesis, based on changes in oxidant-antioxidant status, cell proliferation, apoptosis and angiogenesis in a rat forestomach carcinogenesis model and found that AI and OS combination may be mediated by their antioxidant, antiangiogenic, antiproliferative and apoptosis inducing properties. [Manikandan, 2008] [28] The studies have shown that the chemopreventive effect of OS leaf extract might be mediated through the induction of hepatic/extrahepatic GST in mice. [Prashar & Kumar, 1995] [29] Significant antiproliferative and chemopreventive activities were observed in mice with high concentration of OS seed oil. The potential chemopreventive activity of seed oil has been partly attributed to its antioxidant activity. [Prakash & Gupta, 2000] [19]

Conclusion

It is observed from various studies that the *Ocimum sanctum* have a number of pharmaceutical and medicinal property and according to this it is effective in the treatment of a

number of diseases. Future research on sacred basil should be emphasized for control of various diseases.

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