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A REVIEW PAPER ON MEDICINAL USES OF *TULSI* PLANT (HOLY BASIL)

Review article

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ABSTRACT

Tulsi (Ocimum sanctum) also known as holy basil is an aromatic plant and it belongs to the family *Laminaceae.* This study shows that *Tulsi* leaf extract contain various phytochemical constituents such as saponin, terpenoids, phenol, carbohydrate, flavonoids, glycoside, fatty acids. Its extracts and various phytochemical constituents show that it possesses antimicrobial, antiseptic antioxidant, analgesic, anti-inflammatory, antistress, hypoglycaemic, immunomodulatory, and hypotensive properties. *Tulsi* is famous for treatment of many diseases such as injuries, hepatic disease, viral infection, earache, back pain, hiccup, respiratory disorders, and mental stress. No doubt *Tulsi* plant is a good source of natural products mainly Phytoconstituents and essential oil which can be used as alternative medicine for the treatment of various ailments and human health problems.

Key Words: Traditional medicine, *Tulsi*, Ocimum sanctum, essential oil, Antimicrobial.

INTRODUCTION

Tulsi is a sacred plant of India. It has great spiritual, medicinal and therapeutic value in Hindu belief. Traditionally in India *Tulsi* is planted in the centre of central courtyard of Hindu houses. In Ayurvedic literature plant is also recognised by other synonyms such as *Surasa, Gramya, Bahu Manjari, Vaishnavi, Vishnu Vallabha, Haripriya* etc. The *Tulsi* with green leaves is called Sveta *Tulsi*, another variety is known as Rama *Tulsi*., the *Tulsi* with dark green or purple leaves and purple stem is called Shyam *Tulsi* or Krishna *Tulsi*. It is considered as most important source of medicine and drugs with many secondary metabolites and essential oil recommended for the treatment of malaria, bronchial asthma, diarrhoea, dysentery, skin diseases, arthritis, eye diseases, and chronic fever etc. In addition, it also shows anticancerous, antifungal, antimicrobial, antifertility, hepatoprotective, antiemetic, antidiabetic, analgesic, adaptogenic, cardioprotective properties.[1]

MEDICINAL USES

Tulsi is antispasmodic, appetiser, carminative, galactagogue and stomachic. It is used for stomach cramps, gastric catarrh, vomiting, intestinal catarrh, and enteritis. It has been sometimes used for whooping cough as an antispasmodic. *Tulsi* has antioxidant properties and reduce blood glucose levels. Thus, it is useful for diabetes. *Tulsi* reduces total cholesterol levels. Thus, useful for heart disease patients. *Tulsi* reduces blood pressure. It helps in building up stamina. It has been used for gastric disorders, cough, common colds, malaria, and headaches.it is used as mouth wash for reducing tooth ache. It has immunemodulatory properties. *Tulsi* acts as insect repellent, so it is used to store grains. IT has antiviral, antibacterial, antitubercular, antifungal, antimalarial properties. [2,3,4]

HEALTH BENEFITS OF *TULSI* IN OUR DAILY LIFE

The leaves are nervine tonic which sharpen memory. The leaves strengthen the stomach and induce copious perspiration**.** The leaves are very useful for many fevers. During rainy seasons, when malaria and dengue fever are widely prevalent, tender leaves boiled with tea, act as preventive against these diseases. In case of acute fever, a decoction of the leaves boiled with powered cardamomum in half a litre of water and mixed with sugar and milk brings down the temperature. *Tulsi* is an important constituent of many ayurvedic cough syrup and expectorants Chewing *Tulsi* leaves relieves cold and flu.

Tulsi has strengthening effect on the kidney. In case of renal stone, the juice of basil leaves and honey. If taken regularly for 6 months, it will expel them via the urinary tract. *Tulsi* has a beneficial effect in cardiac disease and the weakness resulting from them. It reduces the level of blood cholesterol. *Tulsi* leaves are regarded as an adaptogen or anti-stress agent**.**

Common paediatric problems like cough, fever, diarrhoea, and vomiting respond favourably to the juice of basil leaves. Its pustules of chicken pox delay their appearance, basil leaves taken with saffron will hasten them.

Tulsi makes a good medicine for headache The herbs are useful in teeth disorders. Its leaves, dried in the sun and powered, can be used for brushing teeth. It is also useful in pyorrhoea and other teeth disorders.

Applied local, basil juice is beneficial in the treatment of ringworm and other skin diseases. It has also been tried successfully by some naturopaths in the treatment of leukoderma. [5,6]

PHYTOCHEMICAL CONSTITUENTS

The *Tulsi* plant containing many nutrients and many biologically active compounds. The leaf volatile oil contains eugenol, eugenol, urosolic acid, carvacrol, linalool, limatrol, caryophyllene, methyl carvicol while the seed volatile oil has fatty acids and sitosterol; The sugar is composed of xylose and polysaccharides. Although *Tulsi* is known as a general and leaves of holy basil contain a variety of constituents that may have biological activity, including saponins, flavonoids, triterpenoids, and tannins. In addition, the following phenolic activities have been identified, which also exhibits antioxidant and anti-inflammatory activities, rosmarinic acid, apigenin, cirisimaritin, isothymusin and isothymonin. [7]

PHARMACOLOGICAL ACTIVITY

Tulsi contains diverse category of phytochemicals which show diverse biological and pharmacological activities few important pharmaceutical activities noted are as follows.[8]

ANTICANCER ACTIVITY

Tulsi contains phytochemicals such as eugenol, rosmarinic acid, apigenin, myretenal, luteolin, β-sitosterol, and carnosic acid prevented chemical-induced skin, liver, oral, and lung cancers and to mediate these effects by increasing the antioxidant activity. aqueous extract of *Tulsi* and its bio-organic constituents, i.e., flavonoids, orintin, and vicenin are shown to protect mice against γ-radiation-induced sickness and reduced the mortality. It selectively protects the normal tissues against the tumoricidal effects of radiation. The other important phytochemicals such as eugenol, rosmarinic acid, apigenin, and carnosic acid are also shown to prevent radiation-induced DNA damage. *Tulsi* plant possesses both chemo preventive and radioprotective effects and found highly effec-

tive in cancer prevention and treatment.[9] *Tulsi* is a dietary herb and well known for its multiple beneficial pharmacologic properties including anti-cancer activity. Plant possesses antineoplastic effects, and it can be used for the prevention and treatment of human cancer. Crude extract of *Ocimum gratissimum* and its hydrophobic and hydrophilic fractions (HB and HL) differentially inhibit breast cancer cell chemotaxis and chemo invasion in vitro and retard tumour growth and temporal progression of MCF10ADCIS.com xenografts, a mole of human breast come doductal carcinoma in situ (comedo-DCIS). OG is non-toxic and obstruct cancerous activity MMP inhibitory activity.[10]. Flavonoid vicenin-2 (VCN-2), isolated from OS when provided in combination with docetaxel (DTL) stop carcinoma of prostate (Cap) [11]. OS Linn (*Tulsi*) extract also shows anti-ulcerogenic property in pyloric and aspirin treated rats. The extract of OSL reduced the ligated and pyloric ligated ulcer index, free, and total acidity on acute and chronic administration. 7 days pretreatment with the drug increased the mucous secretion and reduce acid secretion.[12] OG retards breast cancer growth and its progression. It acts as a natural inhibitor of matric metalloproteases.[10]

ANTIOXIDANT ACTIVITY

Leaves of different species of *Tulsi* showed variable yield of oils and types of chemical constituents. These chemo typic variations also reflect variable antioxidant and free radical scavenging capacity. The yield of oils obtained was greater in OG (3.5%) and least from Ocimum basilicum var. Purpurascens (0.5%).[13] Antioxidant capacity was positively correlated ($r = 0.92$, $P < 0.05$) with a high proportion of compounds possessing a phenolic ring such as eugenol, while a strong negative correlation with other major volatiles was observed [13]. OS L. leaves contain propanoid compounds including eugenol and methyl eugenol as major constituents which decrease serum lipid profile in normal and diabetic animals. It also shows antihyperlipidemic and antioxidative actions against hypercholesterolemia. *Tulsi* oil suppressed the high serum lipid profile and atherogenic index as well as serum lactate dehydrogenase and creatine kinase while in the liver, it decreased high level of TBARS without significantly effecting GPx, SOD and CAT. Ocimum canum a Thai plant shows ant tyrosinase and antioxidant activities. [14] The oil obtained from flowering aerial parts of two Ocimum species, viz., OG and OS showed the presence of principal constituents as eugenol (75.1%) and methyl eugenol (92.4%), comprising 99.3 and 98.9% of the total oils, respectively.[15] oil of OG showed comparative antioxidant activity with IC50 values 23.66 ± 0.55 and 23.91 ± 0.49 µg/ml in 2,2-diphenyl-1-picrylhydrazyl and 2,2'-azino-bis models, respectively. Eugenol showed slightly weaker antioxidant activity compared to oil of OG, while OS oil demonstrated very feeble antioxidant activity and methyl eugenol did not show any activity.[16]

ANTIDIABETIC

Tulsi shows antidiabetic. [17.18] Aqueous extract decreases levels of blood glucose in induced hyperglycaemic tilapia (Oreochromis niloticus).[19] Extracts/fractions of AM and MC were found to inhibit significantly ($P < 0.05$**)** When same treatment was given in vivo on glycogen-loaded mice showed significant ($P < 0.05$) depressive effect on elevation of postprandial blood glucose following ingestion of AM and MC extracts. Both floral and leafy

parts can be used in alternative nutritional therapy mainly for management of diabetes because these inhibit carbohydrate hydrolysing enzymes.[20] Similar antidiabetic activity is reported in tetracyclic triterpenoid isolated from aerial parts of OS. Aerial part of OS test compounds significantly decreases elevated level of serum glucose and also caused to reverse the cholesterol, triglyceride, low density lipoprotein (HDL), and high-density lipoprotein (LDL) values when compared to untreated diabetic rats.[21] Administration of OS to streptozocin-induced diabetic rats for 30 days significantly reduced the plasma level of TBARS and improved the status of the antioxidant enzymes catalase, SOD and GPx in vital organs such as the liver and kidney.[22] Methanolic extract of OS Linn. reverses dyslipidaemia and oxidative stress in alloxan induced type I diabetic rat model.[23].

OT (L.) showed the ability to inhibit glucosidase and α-amylase inhibitory property. The three extracts of OT showed good inhibition of murine pancreatic and intestinal glucosidases as compared with acarbose, a known glucosidase inhibitor.[24] Plant extract also normalize the damage induced by free radicals and show antioxidant properties.[25] OS leaf extracts stimulate insulin secretion from perfused pancreas, isolated islets, and clonal pancreatic beta-cells[26] hypoglycaemic effect.[27] Ethanolic extract of OS leaves partially attenuates streptozotocin-induced alterations in glycogen content and carbohydrate metabolism in rats.[28]

Tulsi leaf powder when provided at the 1% level in normal and diabetic rats for a period of 1-month to it causes significant reduction in fasting blood sugar, uronic acid, total amino acids, total cholesterol, triglyceride, phospholipids, and total lipids. In liver, total cholesterol, triglyceride, and total lipids were significantly lowered. Total lipids were significantly reduced in kidney. In heart, a significant fall in total cholesterol and phospholipids was observed. Tulasi leaf powder shows hypoglycaemic and hypolipidemic effect in animal model.[29]

Similarly, leaf extract showed hypoglycaemic effect (a significant decrease in fasting and postprandial blood glucose levels during the treatment with holy basil leaves compared to during treatment with placebo leaves. The lower values of glucose represented reductions of 17.6% and 7.3% in the levels of fasting and postprandial blood glucose, respectively. Mean total cholesterol levels showed mild reduction during basil treatment period.[30]

ANTIMICROBIAL ACTIVITY

Solvents and water extracts of *Tulsi* have shown antibacterial activity multi-drug resistant S. aureus and MIC was noted 1.56-6.25 mg/ml, whereas higher values (6.25-25 mg/ml) were obtained against the multi-drug resistant isolates Klebsiella pneumoniae and Escherichia coli.[31] Eugenol, methyl eugenol, linalool, and 1, 8-cineole, along with TEO *Tulsi* oils showed strong cytotoxicity to Candida species.[32]

Tulsi contains alkaloids and polyketides active against S. aureus.[33] The colloidal solution of silver nanoparticles exhibits high antibacterial activity against three different strains of bacteria E. coli, Corynebacterium (Gram-positive), Bacillus subtilis (spore forming).[34] Its oil imparts antibacterial activity against S. aureus (Singh et al.). Leaf extract shows antibacterial activity against E. faecalis dentinal biofilm.[35] It is traditionally popular for its gastroprotective effects, including its use as a digestive and anti-diarrheal.[36]

IMMUNOMODULATORY

Tulsi leaf chewing on empty stomach increases immunity. Its alcoholic leaf extract shows immunomodulatory effect [37] *Tulsi* is used for immune-based therapies mainly for treating diseases, control of ecto-and endo-parasites, fertility enhancement, bone setting, and poor mothering management. It also shows immune-modulatory effects such as modulation of cytokine secretion, histamine release, immunoglobulin secretion, class switching, cellular co-receptor expression, lymphocyte expression, and phagocytosis. [38]

ANTI-INFLAMMATORY

Seeds of OS contain oil that possesses anti-inflammatory activity due to dual inhibition of arachidonate metabolism supplemented by antihistaminic activity. Seed oils also possesses antipyretic activity due to prostaglandin inhibition and peripherally acting analgesic activity.[39] It also shows hypotensive, anticoagulant, and immunomodulatory activities. Lipoxygenase inhibitory, histamine antagonistic and antisecretory activities of the oil contribute toward antiulcer activity. Antioxidant property of the oil renders metabolic inhibition, chemoprevention and hypolipidemic activity. The presence of linolenic acid in the oil imparts antibacterial activity against S. aureus.[39]

The activities of 5-lipoxygenase and cycloxygenase-2 and levels of leukotriene B4 and thromboxane B2 were also elevated in ISP-treated rats, which were significantly decreased in [extract pre-treated rats. It also shows antioxidant potential and cardioprotective effect which may be due to the high phenolic content of methanolic extract of OS leaves.[40]

Holy basil (OS) fixed oil contains alpha-linolenic acid which showed anti-inflammatory activity and does significant inhibition of paw oedema in the highest dose (3 ml/kg). OS oil bear higher alpha-linolenic acid content produced a greater inhibition of paw oedema suggesting that modulation of the course of inflammatory disorders may be achieved by altering the eicosanoid precursor PUFA availability through dietary manipulation.[39] OS Linn: Extracts and its phytochemical constituents show anti-inflammatory activity.[18] The bioavailability of flurbiprofen with reference to orally administered flurbiprofen in albino rats was found to increase by 2.97, 3.80 and 5.56 times with transdermal patch formulation without enhancer, *Tulsi* and turpentine oil formulations, respectively. *Tulsi* and turpentine oil enhance penetration potential of transdermal delivery of flurbiprofen, a potent non-steroidal anti-inflammatory.[41] *Tulsi* leaves also show immunomodulatory effects such as modulation of cytokine secretion, histamine release, immunoglobulin secretion, class switching, cellular co-receptor expression, lymphocyte expression, and phagocytosis.[38]

ANTISTRESS ACTIVITY

Fresh leaves of OS cut down oxidative stress that led to a lesser depletion of reduced glutathione (28.80%) and plasma SOD (23.04%) in OS-treated rabbits. This antistressor activity of OS is partly attributable to its antioxidant properties.[42]

HEPATOPROTECTIVE ACTIVITY

The OS alcoholic leaf extract shows significant hepatoprotective activity and synergism with silymarin. In liver, EO and extracts of OS could prevent oxidative stress by increasing glutathione peroxide and catalase and were also effective in prevention of hepatic steatosis.[43] Its major biochemically active constituents such as eugenol, carvacrol, ursolic acid, β-caryophyllene and rosmarinic acid showed anti-inflammatory, gastric and hepatopro-

tective properties.[18] *Tulsi* oil possesses anti-inflammatory activity due to antihistaminic activity. It also possesses antipyretic activity due to prostaglandin inhibition and analgesic activity. The oil has been found to be effective against formaldehyde or adjuvant induced arthritis and turpentine oil induced joint oedema in animals.[39]

ANALGESIC

The oil possesses anti-inflammatory activity due to dual inhibition of arachidonate metabolism supplemented by antihistaminic activity.[39] The alcoholic leaf extract of *Tulsi* shows analgesic activity in mice. This analgesic action exerted both centrally as well as peripherally and involves interplay between various neurotransmitter systems.[44] The bioavailability of flurbiprofen with reference to orally administered flurbiprofen in albino rats was found to increase by 2.97, 3.80 and 5.56 times with transdermal patch formulation without enhancer, *Tulsi*, and turpentine oil formulations.[45]

ANTI-ATHEROGENIC AND ANTI-CVD

Tulsi plant has been traditionally used to treat and manage the cardiac problems. Its leaves significantly change the blood lipid profile after a dose 1 g for 4 weeks in albino rabbit.[46] *Tulsi* polyphenolic extracts were found to have the inherent capacity to inhibit the transcriptional expression of genes, CD-36 and c-myc which control lipid metabolism, cytokine production and cellular activity within the arterial wall.[47]

ANTHELMINTIC ACTIVITY

The EO of OS and eugenol, tested showed potent anthelmintic activity in the Caenorhabditis elegans model. Eugenol being the predominant component of the essential oil is suggested as the putative anthelmintic principle.[48]

ANTIAGING EFFECT

Tulsi plant contains ursolic acids and oleanolic acid as major constituents which are helpful to slow down of cell division and growth.[46]

TULSI USED AS TRADITIONAL INDIAN AYURVEDIC MEDICINE

According to Organic India, an organization dedicated to organic agriculture and sustainable development, one of the qualities that make the *Tulsi* plant such a potent medicinal herb is its ability to reduce stress**.** It strengthens the heart. It acts as an appetizer and promotes digestion too. It facilitates the secretion of digestive enzymes and prevents flatulence. Having detoxifying properties, the *Tulsi* purifies blood of any toxins that might be present in it. *Tulsi* may well provide protection from radiation poisoning. There has come up a belief that a *Tulsi* leaf swallowed daily will ensure protection from cancer. Essential oil extracted from Ocimum basilicum is mostly used for medicinal purposes though of late it is used in the manufacture of herbal toiletry. The Plant Cultures project of the Medicines and Healthcare Products Regulatory Agency of the United Kingdom notes that in Ayurvedic medicine the *Tulsi* plant has been used topically for skin conditions like eczema, ringworm, and insect bites. It is also commonly used to reduce fevers, improve lung and digestion issue reduce the effects of colds, eliminate toxins/poisons and as a preventative antibacterial for infections.[49,50]

CONCLUSION

Tulsi plant contain various bio-organic components, i.e., methyl chavicol, camphor, limonene, camphene and (E)-βocimene, linalool and bicyclogermacrene and

α-terpineol, 1,8-cineole germacrene D, and β-caryophyllene. Minor basil oil constituents are delta-cadinene, 3-carene, alpha-humulene, citral, and (-)-trans-caryophyllene Its leaf EO contain methyl eugenol, (E)-cinnamyl acetate, eugenol and beta-element as major constituents which show multiple biological effectiveness. Its EO is a well-known insect repellent due to presence of camphor, caryophyllene oxide, cineole, methyl-eugenol, limonene, myrcene, and thymol. Plant has vast number of therapeutic applications such as in cardiopathy, hemopathy, leukoderma, asthma bronchitis, catarrhal fever, otalgia, hepatopathy, vomiting, lumbago, hiccups, ophthalmia, gastropathy, genitourinary disorders, ringworm, verminosis and skin diseases etc., *Tulsi* is well known for treatment of bronchitis, bronchial asthma, malaria, diarrhoea, dysentery, skin diseases, arthritis, painful eye diseases, chronic fever, and insect bite. Its plant parts and its chemical constituents showed various pharmacological activities. Plant possesses strong anti-inflammatory, analgesic, antipyretic, antidiabetic, hepatoprotective, hypolipidemic, antistress, and immunomodulatory activities and is a plethora of biological and pharmacological activity. *Tulsi* plant and eugenol work upon immune system, reproductive system, central nervous system, cardiovascular system, gastric system, urinary system, and blood biochemistry. *Tulsi* is highly beneficial in treating conditions such as heart disease, headaches, stomach disorders, hepatitis, malaria, tuberculosis, dengue, and swine flu. Leaf powder and EO is highly useful for dental health and for healthy gums. *Tulsi* plant serve as a fabulous repellent in fighting against flies, mosquitoes, and insects**.** *Tulsi* is used by local people for various herbal preparations such as concoctions, syrups, green tea, and sat. Daily usage of *Tulsi* leaves helps in controlling diabetes and diabetes associated pathologies. Phytochemicals, nutritional, and mineral constituents of different plant species will assist clinicians and pharmacists to prepare anti diabetic drug formulation with an establishment of non-toxic herbal drugs. These could be used as sources of nutrients, and as replacements for synthetic antidiabetic drugs. No doubt indigenous medicinal plants can be used to maximize the production of economically feasible drugs as an alternative of synthetic drugs to treat diabetes. There is a need of natural plant products that can be used for preparation of antidiabetic formulations which could do a significant reduction in blood glucose level in comparison to existing standard anti-diabetic drugs. Various herbal preparations are also used as ethnomedicines by local people in the form of crude extracts prepared from flowers, fruits, roots of endemic plant species.

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