

Pharmacological Evaluation of *Ocimum sanctum*

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Abstract

Tulsi is a Sanskrit word that means “matchless one”. *Ocimum sanctum* is a plant of family Lamiaceae, is commonly known as Holy Basil. Characteristically, the plant imparts a pungent, bitter, hot, light and dry effect. Holy Basil is extensively famous and has been used since centuries in Ayurvedic and Greek medicines owing to its beneficially diverse properties. *O. sanctum* (Tulsi in Hindi) has a significant place in Hindu culture, being used in an array of traditional medicaments and as a condiment. Online published articles, journals, internet sites, Pubmed, Scopus and Google Scholar have been explored for data collection. Since Ayurveda times, various parts such as leaves, roots, seeds and whole plant has been recommended for treatment of a spectrum of diseases including bronchitis, dysentery, malaria, diarrhea, eye ailments, dermatological issues, rheumatoid arthritis, etc. Scientifically, it has been proven that *O. sanctum* possesses anticancer, anti-diabetic, anti-fertility, antifungal, antimicrobial, cardio protective, analgesic, antispasmodic and adaptogenic, immunomodulatory, antioxidant, hepatoprotective, antiallergic, antipyretic, antiviral, antiulcer, anti-inflammatory, CNS depressant and anti-arthritis activities. Its biologically active constituent is known as Eugenol (1-hydroxy-2-methoxy-4-allylbenzene) which is responsible for the mediation of therapeutic characteristics. This review is an attempt to summarize the botanical, pharmacological, phytochemical, ethno medicinal, and toxicological information. This is an effort to help researchers and clinicians to be aware of the magical properties and the effectiveness of Tulsi.

Keywords: *Ocimum sanctum*; Tulsi; Anti-microbial; Pharmacological activities

Introduction

Ocimum sanctum (Tulsi) is a member of family Lamiaceae. Literally Tulsi means “Matchless one”. Also, known as “Queen of Herbs” [1] (incomparable one) (Babita Labh Kayastha). It is one of the holiest plant which exhibits tremendous healing potential [2,3]. This plant exists in two varieties, i.e., Black which is also known as Krishna Tulsi, other is green known as Rama Tulsi [4]. In terms of chemical constituents, both varieties are considered equal. Tulsi covers many domains of medicines like Ayurveda, Siddha, Greek, Roman and Unani medicine system [5,6].

From literature, it is known that Tulsi has been utilized therapeutically since 400-500 BC. Earliest references of Tulsi were found in Rigveda (3500-1600 BC). Therapeutically it is used in anti-cancer, anti-oxidant [7], anti-diabetic [8], radiations [9], infertility and for many other major and minor diseases [10]. Being adaptogenic, Tulsi is used to improve health. Extract of Tulsi is used in ayurvedic treatments for common cold, heart diseases, and stomach disorders, poisoning cases, convulsions, epilepsy, malaria, fever, bronchitis and certain inflammatory problems. Therefore, extract of Tulsi is also known as “Extract of Life” and considered to grant longevity [11].

Tulsi is a wild plant of tropics and warm regions [12]. Tulsi is harvested in sub-continent [13]. It is an erected, branched plant and its height is about 30-60 cm when mature [14]. The plant is acrid and bitter. It grows in moist soil. Tulsi is aromatic and a branched herb covered with minute fine hairs. The herbaceous plant is about 75-90 cm long with its leaves possessing a length of 5 cm long and margin which is toothed. Leaves are aromatic because they contain scented oil in them and they are simple, elliptic, oblong, and obtuse with serrate or dental margins. A variety having green leaves is called Shri Tulsi and that having reddish leaves Krishna Tulsi. It bears small purple reddish flowers, have small cylindrical spikes and rigid clusters [15]. At the base of each flower there are cluster stalk less heart-shaped bracts. Flowers are 5 mm long, with a calyx tube bearded outside the base. Hairy flower tube is present [16]. The fruit is small with yellow to reddish colored seeds. It is native to

India Egypt, France, Italy, USA and Iran. In addition, Basil is found in tropical regions. It grows in warm climates, it is aromatic and bright green to Purple [17].

Classification

Kingdom: Plantae
Division: Magnoliophyte
Class: Magnoliopsida
Order: Lamiales
Family: Lamiaceae
Genus: *Ocimum*
Species: *Sanctum*

Other Names

English name: Holy basil
Hindi: Tulsi
Sanskrit: Tulsi
Gujarati: Tulsi

Methodology

Authors undertook the literature study thoroughly if anywhere

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discrepancies were observed these were resolved unanimously through discussions. Online published articles, journals, internet sites, Pubmed, Scopus and Google Scholar were explored for data collection. For literature search authors used the free words, MeSH terms and controlled vocabulary thesaurus for indexing the articles. Furthermore, unpublished studies were also utilized through conducting interviews with the different traditional medicine practitioners, reading and searching their manuscripts. The following chart illustrates the strategy utilized for data segregation from secondary literature.

Chemical Constituents

The different parts of *Ocimum sanctum* contain different types of constituents in varying amounts. The leaves contain a high content of essential oils which include Toluene, Camphene, Octane, Benzene, Citronellel, Sabinene, Limocene, Ledol, Dimethylbenzene, Ethyl-2-methylbutyrate, Eugenol, Terpinolene, β -elemene, Isocaryophyllene, Iso-eugenol, α -amorphene, α -guaiene, α -humulene, α -terpeneol, Borneol, Calamine, Nerolidol, Carvacrol, Geraneol, Humulene oxide, Elemol, Tetradecanal, (EZ)-famesol, Cissesquisainenehydrate, α -bisbolol, Selin-11-en-4- α -ol, α -murolene, 14-hydroxy- α -humulene [18]. To separate constituents' extraction is performed in many ways. When alcoholic extraction of leaves and aerial parts of plants was done, it was found to contain Luteolin, Orientin, Urosolic acid, Apigenin-7-O-glucuronide, Luteolin-7-O-glucuronide, Isorientin, Aesculin, Triacontanolferulate, Vallinin acid, Gallic acid, Circineol, Aesculetin, Triacontanolferulate, Chlogenic acid, Stigmasterol, Caffiec acid, Urosolic acid, 4-hydroxybenzoic acid, Vicenin-2, Chlorogenic acid, Procatechuic acid, Phenylpropaneglucoisides, β -Stigmasterol. Seeds of this plant are chief source of fixed oils such as Oleic acid, Stearic acid, Hexourenic acid, Palmitic acid, Linodilolinol and Linolenic acid. The extraction of fresh leaves and stem yielded phenolic compounds like Apigenin, Circimaritin, Isothymusin, Eugenol and Rosameric acid [19]. *O. sanctum* is also a source of monoterpenes and sesquiterpenes like Neral, Campene. Cholesterol and stigma sterol [20]. Vitamin A and Vitamin C are also found in this herb which stimulates antibody production up to 20% to provide protection against diseases [11,21,22].

Pharmacological Activities

Antimicrobial activity

In 1952 Joshi and Rao studied its activity against pathogens like *Escherichia coli*, *Staphylococcus aureus*, *Bacillus anthracis*, *Bacillus subtilis*, *Salmonella* spp., *P. vulgaris*, *Pseudomonas aeruginosa* and *Mycobacterium tuberculosis* [15,23] and found its activity against *E. coli*, *Klebsiella aerogens*, *Proteus mirabilis*, *Salmonella typhimurium*, *Shigella dysenteriae*, *Vibrio* spp., *P. aeruginosa*, cholera and *S. aureus*. In 2008 Jabeen et al. found activity against *Pasturella multocida*, *E. coli*, *S. aureus*, *B. subtilis* and *Salmonella typhi*, *Salmonella paratyphi A* and *Salmonella typhimurium* and *E. coli*, *Klebsiella* spp., *B. subtilis*, *S. aureus* [24]. In 2010, Kumar et al. performed *in vitro* studies against specific pathogens under laboratory conditions and saw the growth or the inhibition of the pathogen and observed effects for specific period of time. Essential oil of Tulsi leaves have significant inhibitory effect against *E. coli*, *B. subtilis*, *B. anthracis*, *S. aureus*, *Pseudomonas vulgaris* and *P. aeruginosa*. These essential oils include major constituents of leaves such as caryophyllene; eugenol, methyl eugenol which are effective against *Arthobacterglobiformis*, *B. megatherium*, *E. coli* and *Pseudomonas* sp. Grover and Rao in 1977 stated that Eugenol is the most therapeutically effective constituent of Tulsi [25-27]. Aqueous and alcoholic extracts of leaves impart a potentially effective antibacterial activity. The extract is effective against various enteric pathogens viz., *E. coli*, *K. aerogens*,

P. mirabilis, *Salmonella typhimurium*, *Shigella dysenteriae*, *P. aeruginosa*, *Vibrio cholera* and *S. aureus* [28,29]. Antibacterial activities of seeds were also studied and it was revealed that the crude, supernatant, residue and dialyzed samples obtained from the seeds inhibited the growth of *P. multocida*, *E. coli*, *B. subtilis* and *S. aureus*. In 2008, Jabeen et al stated that *P. multocida* and *B. subtilis* were most sensitive strains as they were susceptible to minimum inhibitory concentration. *In vitro*, aqueous and methanolic extracts of *Ocimum sanctum* leaves exhibited anti-salmonella activity and against pathogenic *Salmonella typhi* [25] it was also discovered that aqueous extract was more active than methanolic extracts. In 2011, growth inhibition of *Klesbiella*, *E. coli*, and *Proteus* and *S. aureus* by aqueous extract was studied. On the other hand, the aqueous extract has activity against the notorious multidrug-resistant strains of *S. aureus* which show resistance to beta lactam antibiotics. *O. sanctum* is also active against resistant strains of *Neisseria gonorrhoea*, the fixed oil has an efficient good antibacterial activity against *Bacillus pumilus*, *P. aeruginosa* and *S. aureus*. Linoleic acid also has antibacterial activity. In addition to antibacterial the essential oil also has insecticidal properties. It has ten times the anti-tubercular potency of streptomycin and approximately one-fourth times the activity that of isoniazid. The essential oil is effective against pathogenic fungi including *Alternaria solani*, *Candida guilliermondii*, *Colletotricum capsici*, *Curvularia* spp., *Fusarium solani*, *Helminthosporium oryzae* and the bacterial strains, *Anthrobacter globiformis*, *Bacillus megatherium*, *E. coli*, *Pseudomonas* spp., *S. aureus*, *S. albus* and *Vibrio cholerae* [30]. The essential oil has activity against both Gram-positive as well as Gram-negative bacteria. For enteric pathogens, aqueous extract and alcoholic extract is beneficial while on the contrary, seed oil of Tulsi yields considerable antimicrobial properties. The ethanolic extract inhibits methicillin-resistant *S. aureus* (MRSA) which is notorious for the production of B-lactamases and significant activity is also demonstrated against methicillin-sensitive *S. aureus* [MSSA]. The oils have antimicrobial activity against *Propionibacterium acnes*. It has minimum inhibitory concentration (MIC) of 3.0% v/v. Viral encephalitis patients benefit from aqueous extract. Tulsi leaves paste was found effective against ring worm infections. Tulsi naturally possesses antimicrobial properties and is used in the treatment of many serious systemic diseases and localized infection. With fresh juice and honey, worms and parasites are removed; the sweetness excites the parasites out. It is used in the treatment of viral encephalitis, malaria and typhoid [20]. Tulsi demonstrated effective antimicrobial property against *Aggregatibacter actinomycetemcomitans*, suggesting its possible use as an effective and affordable "adjunct" along with the standard care in the management of periodontal conditions [11,31-33].

Anticancer

In modern world, cancer is a leading cause of death. Cancer treatment options such as surgery, radiotherapy and chemotherapy are costly, have serious side effects and residual morbidity. It has been found that ethanolic extract of Tulsi produces a reduction in tumor size and an increase in the life expectancy of mice that have Sarcoma-180 solid tumors. This result has also been demonstrated by anticancer activity of *Ocimum sanctum* in Lewis lung carcinoma animal model. Ursolic acid has anticancer property. *O. sanctum* provides a protective effect on DNA from harmful radiations. *O. sanctum* is significantly useful against a variety tumorigenesis states. The administration of aqueous and alcoholic extracts of *O. sanctum* to mice having Solid Sarcoma-180 tumors leads to a considerable reduction in tumor size [34]. Tulsi extract also has an anti-inflammatory and free radical scavenging potential which also play a crucial role in reducing certain type of cancerous cell growth. Ursolic acid and Curcumin isolated from Tulsi

has an anti-inflammatory, cyclooxygenase inhibitory and antioxidant activity. *O. sanctum* increases the production and storage of glutathione and produces an increase in glutathione-S-transferase activity by approximately 78% in mice [35]. In Dalton Lymphoma ascites tumor model in Swiss, the chemo preventive effect and anti-tumor growth of *O. sanctum* L., were observed in Albino mice. The crude herb ingestion leads to an increase in the survival time and produces a reduction in the peritoneal ascetic fluid in a DMBA (7,12-dimethylbenz[a]anthracene) induced rat hepatocyte. There was dose dependent decrease in the levels of DMBA-DNA by using extract. It is stated that *O. sanctum* leaf extract produces a reduction in chemical carcinogenesis through the metabolic activation pathway inhibition in the carcinogen seed [36]. Oil of *O. sanctum* is effective as a chemo preventive agent against the development of fibro sarcoma in Swiss albino mice induced through a subcutaneously injected 20-methylcholanthrene. This produces an increase in the survival rate and delay in tumor incidence when administered to mice. The end product lipid peroxidation and Liver enzymatic and malondialdehyde levels were considerably altered when oil was given to mice as compared to untreated mice that had been injected with 20-methylcholanthrene. The chemo preventive potential is thus, due to the antioxidant properties and produces a considerable reduction in tumor size. In rats, the radio-protective effect was studied stated by administration on the salivary glands and the activity was compared with a radio protectant, amifostinepre. *O. sanctum* and amifostinepre-supplemented and consequently given to rats for 3 and 6 months with positive results on high dose [37]. Alcoholic root extract of tulsi is also effective against lung carcinoma cells [38].

Immunomodulatory activity

Modifications in the humoral immune response in rats was observed when treated with distilled extract of fresh leaves attributing to mechanisms like antibody production, tissue responses, release of mediators of hypersensitivity in specific organs. Seed oil was observed to regulate both cell mediated and humoral immune response. The GABA pathways may demonstrate the immunomodulatory effects. Tulsi enhances both cellular and humoral immunity [39]. Mukherjee et al. stated that aqueous extract of leaf had immunotherapeutic potential in sub-clinical trials of bovine during intra-mammary aqueous extract infusion and it was also stated that *Ocimum sanctum* L. aqueous extract produces a reduction in the bacterial total count and an increase in the count of neutrophil and lymphocyte and demonstrated a good phagocytic ability [40]. Mediratta et al. studied the immunomodulatory effects produced by *O. sanctum* L. seed oil in both non-stressed as well as stressed animals for some immunological parameters. Consequently, it was stated that Tulsi seed regulates both humoral and cell-mediated immune responses mediated by GABAergic pathway. Godhwani et al. checked the immunoregulatory effect demonstrated by both methanolic extract along with an aqueous suspension of Tulsi leaves for the treatment of antigenic challenge provoked by *Salmonella typhosa* together with sheep erythrocytes and to quantify antibodies that had been agglutinating by Widal agglutination and sheep erythrocyte agglutination tests and in albino rats [39,41,42]. The results indicated an immune stimulation of humoral immunogenic response due to increased antibody titer in the Widal together with sheep erythrocyte agglutination tests. An immunomodulatory response balances and improves the body's response in fighting antigens as bacteria, microbes, viruses, allergens etc. [43]. Tulsi is an effective immunomodulatory plant. Modification in the humoral immune response was observed by distilled extract of fresh leaves. Aqueous extract of leaves *in vitro* showed that leaves had proliferative as well as inhibitory effect on splenocytes. In comparison to negative control, 42.17, 55.42 and 47.38% increase

in the proliferation of spleen cells were reported when splenocytes culture was treated with 31.25, 62.5 and 125 µg/ml Hot aqueous extract of *O. sanctum* In comparison to positive control, spleen cells with Hot aqueous extract of *O. sanctum* leaves in presence of Con-A exhibited 1.25 and 12.36% increase in the proliferation of spleen cells when splenocytes culture was treated with 31.25 µg/ml and 62.5 µg/ml HAE of *O. sanctum*, respectively. The methanolic extract together with an aqueous suspension of *O. sanctum* leaves produced clinically evident immunostimulation of humoral immunological response [44].

Studied that when *O. sanctum*, ascorbic acid and verapamil were given to experimental animals exposed to cocaine, they enhanced the macrophage function and decrease oxidative stress. Aqueous and ethanolic extract of leaves was used to study immunomodulatory activity on specific and nonspecific immunity in mice, that show strengthening of both specific and non-specific responses that can be assessed with haemagglutination antibody (HA) titer, neutrophil adhesion test, Delayed Type Hypersensitivity (DTH) [42,45].

Antifungal activity

Tulsi is effective against *Aspergillus fumigates*, *Aspergillus Niger*, *Candida albicans*, *Cryptococcus neoformans*, *Microsporium cassis*, *Sporotrichum schenkii*. 0.3 g of the essential oil/250 g grains showed best repellent activity against Sitophilus Fungal pathogens are always hard nuts to crack in medical sciences. Scientists have tried extract of *Ocimum sanctum* against some well-known fungal agents as *C. albicans* [46] *Aspergillus flavus* and aflatoxin B1 (AFB1) production [46], *A. niger*, *Aspergillus repens*, *Curvularia lunata* and *Fusarium moniliforme* [47]. Ethanolic extract of *O. sanctum* was reported to have 21-30 mm zone of inhibition against *C. albicans* and were less effective in comparison to aqueous extract Leaves extracts have been found effective for *Fusarium solani* f. sp. Melongenae. they were also found to inhibit the *A. flavus* growth (65-78%) and AFB1 production (72.2-85.7%) [48]. when these extracts were interacted with ferrocyanides of Manganese, Silver Titanium against *A. niger* the metal ferrocyanides complexes showed more antifungal property. New studies are now utilizing different dosage forms and ways to evaluate antifungal properties of Tulsi [49-52].

Hepatoprotective activity

By acting as a part of detoxifying system, it improves the elimination of toxic chemicals and act as a hepatoprotective agent [15]. The study showed that when alcoholic extract of Tulsi plant orally administered, it exhibited hepatoprotective effect against Paracetamol, Carbon tetrachloride and anti-tuberculosis drugs induced liver injury in albino rats. When extract of *Ocimum sanctum* were used in male albino rats weighing 100-150 g of Wistar strain (5-6 weeks) the level of enzymes was reduced. Biometry Research Unit, Indian Statistical Institute, 203 revealed that cold water extract of Tulsi plant produced hepatotonic effect against Paracetamol and Carbon tetrachloride when albino rats fed orally for 6 days with Tulsi extract [53]. When Tulsi extract is used as adjunct with silymarin it show significant hepatoprotective effect [54].

Antiviral

The essential oils like Eugenol of Tulsi leaves produce anti-viral activity [10]. Different types of extracts of *Ocimum sanctum* have anti-viral activity against different viruses e.g. Hematopoietic Necrosis Virus (IHNV) [15,55], polio virus type 3 [56], herpes virus (HSV), hepatitis B virus, New castle Disease Virus. Ethanolic extract of Tulsi plant leaves in a range of 22.5 mg/ml concentration inhibit replication of polio type 3 virus in VERO cells. The extracted components of this

plant like linalool, apigenin and ursolic acid show broad spectrum antiviral activity against DNA viruses like RNA virus and adenoviruses [15,57,58]. One study also proves its efficacy against new castle disease of poultry [59].

Wound healing

Wound healing activity of *Ocimum sanctum* is also proved by using two different types of concentration (200 and 400 mg/kg) in rats. The models of wound used for this study are: the excise, the incise and dead space wound model. By using Van Gieson and Masson Trichome stains in histological examination of determination of granuloma tissue, it is found that Ascorbic acid, Hexose amine, L-Hydroxyproline and Malondialdehyde isolated from Tulsi has wound healing activity. Tulsi can be used as adjunct therapies for the burn wound management many studies supporting its use in healing [57,60,61].

Cough and Sore Throat

Tulsi plant is very effective component of many Ayurvedic cough syrups. The leaves treat cold and flu when chewed. Boiled water of leaves is used in case of sore throat to impart a soothing effect [62,63]. Since ancient times, tulsi is being used for minor throat infections and coryza cough as a inhalation without any adverse effects in children [64,65].

Antihyperlipidemic effect

The fixed oils are used as lipid lowering agent. It has been proved by research on rats observed the lipid lowering effect of *Ocimum sanctum* by feeding them with high fat diet [62]. It normalizes lipids and inhibits the process of Lipid peroxidation whereby, lipids are deteriorated through oxidation [20]. The effect was mainly due to Linoleic acid and Linolenic acid. Another study shows hypolipidemic effect by administering seed oil in rabbits and fresh leaves of *O. sanctum* in albino rats which lowers level of cholesterol, VLDL and triacylglycerol and enhance HDL cholesterol and total sterol content in fecal matter [5]. In Streptozotocin induced diabetic rats, aqueous extract of plant was administered for eight weeks and decrease in lipid profile was observed [66].

Radioprotectant

In 2011, Joseph et al. observed the effect of Tulsi against radiations by exposing salivary glands of rats with radioiodine and compared its radio protective effect against a well-known radioprotectant, Amifostine. Flavonoids obtained from leaves of *Ocimum sanctum* have radio protective activity due to antioxidant effect on the erythrocytes in case of oral cancer. Tulsi showed promising potential in providing protection against radiation poisoning and mediating repair cycles.

The flavonoids e.g. vicenin and orientin from leaves of *O. sanctum* exhibit protection against clastogenic effect of radiations in human lymphocytes at low and non-toxic doses. The sanctum leaf extract provides bone marrow protection when given in combination with WR-2721 and reduced its toxicity in higher concentrations [67].

Antiarthritic activity

Against formaldehyde-induced arthritis in rats, activity of fixed oils of OS was observed that reduced the diameter of inflamed paw. When fixed oils were administered daily for 10 days intraperitoneally, great improvement was seen in the arthritic issues in rats. The fixed oil inhibits inflammation through reducing the effects of carrageenan and certain other inflammatory mediators (e.g. serotonin, bradykinin, histamine and PGE2) [10,68].

Antipyretic activity

The antipyretic activity of the fixed oil was tested against typhoid-paratyphoid A/B vaccine-induced pyrexia. It was observed that the reduction in febrile response indicates the its antipyretic activity, the fixed oil possesses a prostaglandin inhibitory activity [41,68,69].

Anticataract activity

In experiment of cataract (galactosemic cataract in rats induced by the application of 30% galactose and naphthalene cataract induced in rabbits by the application of 1 g/kg naphthalene). The process of cataractogenesis was delayed. It delayed the onset and subsequent maturation of cataract [70,71].

Adaptogenic/antistress activity

In swimming mice, the Aqueous extract of OS produces an increase in the physical ability (survival time), decreases stress induced ulcers and milk induced leucocytosis. Adaptogen produces a decrease in intensity and the stress negativity, infection, emotional difficulties, disease and other factors [72]. Tulsi is known as a good adaptogen. The alcoholic extract of OS produces an increase in physical endurance [73].

Anticoagulant activity

The OS fixed oil (3 ml/kg) demonstrates a prolongation in blood clotting time in a response that is comparable with aspirin (100 mg/kg). This is due to the anti-aggregator action produced by Tulsi oil on platelets [15,74,75].

Anthelmintic activity

The essential oil of *Ocimum sanctum* and eugenol, tested *in vitro*, showed potent anthelmintic activity in the *Caenorhabditis elegans* model. Eugenol exhibited an ED50 of 62.1 µg/ml. Eugenol being the predominant component of the essential oil, is suggested as the putative anthelmintic principle [76,77]. Ursolic acid found in Tulsi has great potential to paralyze and kill worms when its extract activity in comparison with albendazole [78].

Antidiabetic activity

Tulsi exhibits antidiabetic activity, as was revealed in one study, it was observed that aqueous extract of Tulsi significantly lowers the blood glucose level in diabetic rats [8,79]. Similarly, other studies also confirm a fall of fasting blood sugar level and HBA1c was also contributed by the hypoglycemic effect of Tulsi [80,81]. Tulsi is also effective for metabolic syndromes can be used as adjunct with other therapies [8]. It is effective in liver disease and improves the metabolic breakdown of toxins. It helps to balance plasma glucose levels and insulin mediated metabolism and produces a reduction in fasting blood glucose [20].

Miscellaneous activities

Tulsi also has ulcer-healing properties. It acts as a cardio tonic and prevents heart attack, lowers stress and normalizes blood pressure, also has blood thinning properties. It has Anti-arthritis, Anabolic activity, enhances muscle mass and strength by accelerating protein synthesis. It provides comfort to sore eyes and is beneficial for night blindness (Vitamin A deficiency). The juice of Tulsi mixed with honey is used as eyewash to treat conjunctivitis and is also used as Anti-consultant. It corrects and regulates the levels of neurotransmitter in the human brain and also influences the neurochemistry of the brain. Tulsi extract sharpens memory [11,31-33].

Conclusion

Several research offers evidence that Tulsi is useful against stress; it enhances stamina and increases efficient use of oxygen by body; strengthens immune system; reduces inflammation; protects from radiation; reduces aging; supports the lungs, liver and heart; it exhibits antibiotic, antiviral and antifungal, antioxidant properties. Different parts of plant have been used in Ayurvedic ancient Medicine to cure an array of ailments including common cold, cough, headache, flu, asthma, fever, colic pain, sore throat, bronchitis, hepatic diseases, malaria fever, as an antidote for snake bite, flatulence headaches, fatigue, skin diseases, wound, insomnia, arthritis, influenza, digestive disorders, night blindness, diarrhea. Tulsi acts as an adaptogen that helps the body and mind to encounter different physical, chemical emotional and infectious stresses, and restore physiological and psychological functions. Such significant and health promising potential, in addition to its highly specific therapeutic actions, paved way for the broad range of Tulsi's traditional medical uses, and also contributes for its mythological importance and religious sanctity.

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