Exploring the Therapeutic Mechanism of Tulsi in Traditional and Modern Medicine

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Abstract - Today's lifestyle has undergone significant changes, characterized by fast-paced routines, increase stress levels, and unhealthy poor diets, lack of physical activity, and overdependence on technology. This shift has led to an increase in lifestyle-related diseases such as obesity, diabetes, hypertension, and mental health disorders. In this scenario, Ayurveda plays a crucial role in restoring balance and promoting holistic well-being. As a traditional system of medicine, Ayurveda emphasizes natural remedies, proper diet, and lifestyle changes to maintain health. Tulsi (Holy Basil) (Osmium sanctum Linn) plays a vital role in traditional medicine, particularly in Ayurveda, and is highly valued for its numerous health benefits. Tulsi is rich in antioxidants and essential oils, which strengthen the immune system and help the body fight infections. Tulsi is effective in treating respiratory issues like cough, cold, asthma, and bronchitis. Regular consumption of Tulsi can help regulate blood sugar levels due to its hypoglycaemic properties. Tulsi improves digestion, reduces bloating, and helps alleviate stomach disorders like acidity or indigestion. In Indian culture, Tulsi is revered as a sacred plant and is believed to purify the environment and create positive energy. Incorporating Tulsi in daily life, such as drinking Tulsi tea or using its leaves in remedies, can significantly enhance overall health and well-being.

Key words: Adaptogen, Ayurveda, , Osmium sanctum, stress, Tulsi , cortisol

I. INTRODUCTION

Modern lifestyle is characterized by the extensive use of technology, making daily tasks more convenient and communication faster. Urbanization and globalization have created a fast-paced and interconnected world. While digital tools and work-from-home options offer flexibility, they can blur the boundaries between personal and professional life. Increased screen time and sedentary habits often lead to health issues, such as obesity and stress. Social media connects people globally but can also contribute to mental health challenges. Advanced healthcare and fitness technologies improve overall well-being, while modern education emphasizes online learning and skill development. However, environmental concerns arise due to overconsumption and reliance on non-renewable resources. Fast food and convenience diets often replace traditional healthy meals. In this case, Ayurveda plays a vital role in restoring balance and promoting holistic well-being. As a traditional system of medicine, Ayurveda emphasizes natural remedies, proper diet, and lifestyle changes to maintain health. Ayurveda uses native herbs and plant extracts for action of many complicated diseases. Ayurvedic remedy is made by using herbs, minerals, and animal products. It is believed that natural remedies have minor side effects and can be more effective than orthodox medication. [1]

II. Role of ayurveda in today's lifestyle

In modern times, Ayurveda has gained significant relevance as people increasingly turn to holistic and natural approaches to health. Rooted in personalized care, Ayurveda emphasizes treatments based on an individual's constitution (Prakriti) and current imbalances (Vikriti), aligning closely with modern personalized medicine. Its preventive focus, through diet, lifestyle, and seasonal practices (Ritucharya), addresses the rising need for

wellness and chronic disease management. Ayurvedic remedies, including herbal medicines and natural therapies, provide alternatives to synthetic drugs, especially for managing stress, lifestyle disorders, and chronic conditions. Practices like yoga, meditation, and oil therapies (Abhyanga and Shirodhara) are widely embraced for mental and physical well-being. Modern research increasingly validates Ayurvedic principles, such as the anti-inflammatory properties of turmeric or the importance of gut health, paralleling the concept of Agni. Global adoption of Ayurveda-inspired practices like detox diets, herbal teas, and adaptogen herbs highlights its growing appeal. However, challenges like standardization, scientific validation, and public awareness remain crucial for integrating Ayurveda into mainstream healthcare. By fostering balance in body, mind, and spirit, Ayurveda continues to resonate with contemporary wellness philosophies.

III. Tulsi-

Tulsi, Queen of herbs, the fabulous 'Incomparable one' of India, is one of holiest and most precious of healthy giving herbs of the orient. It has been used for thousands of years in ayurveda for its miscellaneous curative properties [2] .Tulsi is scented shrub in the basil family Lamiaceae (tribe ocimeae) that is believed to have originated in north central India and now cultivates native throughout the eastern world tropics [3]. Tulsi are used for common colds, headaches, intestinal disorders, inflammation, heart related problems etc. Tulsi extract are used in many forms, such as herbal tea, dried power or eventually fresh leaves. Dried basil leaves have been mixed with stored grains to repel insects [4].

Systematic position-

- Kingdom - Plantae
- Phylum- Angiosperm
- Class- Magnoliopsida
- Order- Lamiales
- Family-*Lamiaceae*
- Genus-*Ocimum*
- Species- *Ocimum tenuiflorum / sanctum*
- Binomial name - *Ocimum tenuiflorum L* or *Ocimum sanctum L*. [5]

IV. Morphology-

Tulsi is an erect, branched shrub, 30–60 cm tall with hairy stems. Leaves are green or purple; they are simple, petiole, with an ovate blade up to 5 cm (2 in) long, which usually has a somewhat saw-like margin; they are strongly aromatic, opposite, elliptic, oblong with minutely dotted gland. The flowers are purple in colour which are placed in close whorls on elongated racemes. Fruits are smooth nutlets in type [6].

V. Nutritional properties-

As per RAD nutritional value per 100 mg –

Energy is 23 Kcal , protein is 3.15 gm , carbohydrates is 2.65 gm, total fat is 0.64 gm , fibre is 1.60 gm , crypto-xanthin-ß is 0.000046 gm , lutein-zeaxanthin is 0.0056 gm , carotene-ß is 0.0031 gm . Tulsi leaves have high source of Vit- A (2.5 mg/100g), Vit-C (85mg/100g) and minerals. This is superior to synthetic Vit- C as the absorption is very higher the bioavailability of the natural Vit- C is greater than that of the synthetic forms. Various metal like iron and zinc are also found in the leaves. Manganese and Sodium are present in leaves like a trace elements [7].

VI. Properties of Tulsi-

Tulsi is probably best examples of Ayurvedic overall treatment. Tulsi can have minty, peppery, clove-like and bitter taste and is said to penetrate the deep tissues. Daily intake of tulsi is prevent some complication, induce general health, welfare and permanency and promote in dealing with the anxieties of daily life. Tulsi is also credited with giving of sweetness to the vocal sound and enhancement of beauty, cleverness, strengths and a cool down mental disposition [8, 9,10,1].

Tulsi has following properties-

- Antimicrobial (including antibacterial, antiviral, antifungal, antiprotozoal, antimalarial, anthelmintic)
- mosquito repellent
- anti-diarrheal
- anti-oxidant
- anti-cataract
- anti-inflammatory
- chemo preventive
- radio protective
- hepato-protective
- neuro-protective
- cardio-protective
- anti-diabetic
- anti-hypercholesterolemia
- anti-hypertensive
- anti-carcinogenic
- analgesic, anti-pyretic
- anti-allergic, Immunomodulatory
- central nervous system depressant, memory enhancement
- anti-asthmatic, anti-tussive
- diaphoretic,
- anti-thyroid
- anti-fertility,
- anti-ulcer
- anti-emetic
- anti-spasmodic
- anti-arthritic
- adaptogenic
- anti-stress
- anti-cataract
- anti-leukodermal
- Anti-coagulant activities [9, 10,1,11]

VII. Pharmacological components of Tulsi-

Conventionally, tulsi was used for the management of diarrheal condition, chronic fever, malarial disease, skin disease, bronchitis, dysentery, arthritis, and bronchial asthma etc [12,13]. It has many phytochemicals compounds such as terpenoids, phenolic, flavonoids, glycosides, and propenyl phenols [14]. The chemical compounds included in tulsi are listed in table 1-

Table 1. The chemical constituents of O. sanctum.

Group of Chemical Constituents	Name of Chemical Constituents	Reference
Phenolic	Vanillin, Methylisoeugenol, Vanillic acid , Sinapic acid, p-coumeric acid , p-hydroxybenzoic acid , Ferulic acid ,Eugenol , Bieugenol	15, 16, 17
Flavonoids	Galuteolin ,Isovitexin ,Chrysoeriol, Isothymusin Cirsilineol, Isothymunin ,Cirsimaritin , Molludistin, Vitexin, Orientin, Isoorientin ,Vicenin ,Luteolin-5-glucoside , Esculin ,Esculectin	15, 18
Phenylpropanoids Monoterpenoids	Rosmarinic acid, Estragole, Carvacrol, Linalool, Terpinyl acetate, Terpiniolene , Bornyl acetate, Bergomatene	16, 19
Unsaturated hydrocarbons	1,2,4- Trimethylcyclohexane	15
Sesquiterpenoids	Bergomatene , Spathulenol, Humulene Guaiol, 2-Methylene-4,8,8-trimethyl-4-vinylbicyclo[5.2.0] nonane	15,16,17,18, 20,21
Triterpenoids	Oleanolic acid Ursolic acid	

VIII. Physiological benefits-

i. Detoxification-

These functional properties are recognized to tulsi's high content of phenolic components and anti-oxidant properties. In black/purple variety of Krishna tulsi having a higher phenolic content and anti-oxidant capacity than white wild type Vana tulsi [22]. Tulsi helps to prevent cancers which are caused by deadly compounds by decreasing DNA damage [23] and promoting apoptosis in precancerous and cancerous cells, as a result reducing the growth of trial tumors and enhancing survival [24,25]. Queen of herbs not only defends against the damage caused by toxic compounds, but also empowers the body to more effectively

transform and remove them by improving the activity of liver detoxification enzymes like cytochrome P_{450} enzymes, which neutralizes toxic components and excreted safely [26].

ii. Reduces body temperature (antipyretic) and pain (analgesic)-

Tulsi leaves are sought after for their Immunomodulatory and antimicrobial properties. Tulsi, is exhibit antipyretic and diaphoretic action, promoting sweating and assisting in controlling raised body temperature during fever [7].

iii. Antidiabetic-

Ethanolic extract of tulsi lowering the blood glucose, HbA_1C and urea with a concomitant increase in glycogen, haemoglobin and protein in Streptozotocin-treated diabetic rats. This extract results increase in insulin and peptide levels and glucose tolerance [27].

iv. Stress –

Tulsi leaves have Ocimumosides A and B compound, which are known for stress-reducing element and their ability to maintain balance in neuro-transmitters like serotonin and dopamine in the brain. Tulsi plays as a stress reliever agent [28].

v. Cardiovascular Disorder-

Tulsi has confirmed progressive effects on heart health, effectively helping to inhibit cardiovascular disorders by decreasing blood lipid levels, reducing the risk of ischemia and stroke like problems, mitigating hypertension, and connecting its strong antioxidant properties [28]. It has been shown that its management leads to an extraordinary lowering in fasting and PP blood cholesterol levels, mean total cholesterol levels [29].

vi. Gastro-protective –

Optimal effective dose (100 mg/kg) of tulsi revealed significant ulcer protective against ethanol and pyloric ligation induced gastric ulcer but was unsuccessful against aspirin-induced ulcer [30].

vii. Anticancer –

Garden-fresh paste of leaf (topically) aqueous and ethanolic extract (orally) for chemoprotective action against 7,12-dimethylbenzaanthracene (DMBA) induced (0.5%) hamster oral pouch carcinogenesis [31].

Enzymatic, non-enzymatic antioxidants activity of liver and lipid peroxidation activity end product, malondialdehyde level were mark fully modulated with seed oil O. sanctum L. treatment as compared to untreated 20 methylcholathrene injected mice. The chemoprotective activity of seed oil was assessed against subsequently introduced 20-methylcholanthrene-induced fibro sarcoma tumors in thigh region of Swiss albino mice [32]. The increase survival rate and delay in tumour incidence was seen in seed oil supplemented mice.

viii. Parasiticidal activity-

The anthelmintic properties of the essential oil from tulsi was evaluated by *Caenorhabditis elegance* (roundworm) model. Eugenol exhibited an ED50 of 62.1 µg/ml and being the predominant compounds of the essential oil, it was recommended as the recognised parasiticidal principle [33].

ix. Anti-inflammatory properties-

Eugenol is a potent antioxidant as it has been used to reduce the inflammation to the treatment of acute respiratory syndrome like SARS-coV-2. Researchers have done an experiment, they treat a SARS-coV-2

infected mice by Eugenol and found it can reduce its inflammation of lungs and body fever. From experiment, they find that Eugenol can reduce the NF-$_k$β activation and it can also reduce the expression of IL-6 and TNF-α to SARS-coV-2 infected mice [34]. Researchers have identified rosmarinic acid, caffeic acid and apigenin which are polyphenolic compounds found in the extract of O. sanctum show its anti-cancerous and anti-oxidative activity [35].

IX. Tulsi- Gift from Heavens-

In Indianan tradition, Tulsi was worship that it had its own carnival. In Hindu religions celebrated as a goddess, plants were believed that to protect family from evil spirits. Tulsi plant in home as divine bodyguard having refreshing minty smell [36]. Hindu families are considered incomplete without a tulsi plant- especially in a decorative clay pot placed in front yard where tulsi serves practical and ritualistic purposes. Tulsi is combined into regular life through evening and morning rituals and intake tulsi tea [37]. Tulsi wood or seeds are used to make as tulsi malas, which are cords of beads used for helping focus of mind meditation. Tulsi is used in metropolises to prevent air pollution and much more of tulsi plants implanted nearby the TajMahal into Agra to help defend the famous marble building from environmental pollution damage [38].

X. Mercury in Tulsi- misconception-

For various activities like industrial development and suburbanization, heavy metal contaminated of earth-soil and drinking water including lead, silver, and cadmium etc. [39]. Lead flows via the vascular tissues of plant and collect in specific locations of another regions [40]. Tulsi protects against the dangerous effects of heavy metals such as lead, arsenic, cadmium and mercury, also the toxic effects of radiation in addition to guarding alongside toxic chemicals [41].

XI. Conclusion:

From this review, we can say that tulsi and its components has therapeutic and medicinal properties, can reduce the oxidative stress as it has anti-oxidative, anticancer, gastro-protective, anti-diabetic, cardio-protective properties through improving the enzymatic, non-enzymatic level and reducing the inflammation.

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