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Review Article

Overview on Tulsi

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ABSTRACT

Tulsi (*Ocimum sanctum*), also known as Holy Basil, holds a special position in traditional medicine and Ayurveda. This plant has extensive therapeutic properties. It is rich in bioactive compounds, such as eugenol, ursolic acid, and rosmarinic acid. The plant exhibits potent anti-inflammatory, antimicrobial, and adaptogenic effects (Pattanayak et al., 2010). Scientific research highlights role of Tulsi in modulating stress responses, boosting immunity, and acting as a natural remedy for infections (Cohen, 2014; Prakash & Gupta, 2020). Modern pharmacological studies support its effectiveness in managing lifestyle issues, such as diabetes and cardiovascular diseases. Additionally, Tulsi's antioxidant properties make it a potential candidate for neuro-protection and anti-aging applications (Bhattacharyya et al., 2017; Prasad & Kumar, 2021). With increasing global interest in herbal medicine, Tulsi is expected to be a focal point of research, bridging traditional knowledge with contemporary scientific advancements.

INTRODUCTION

Ocimum sanctum is often referred to as the "Queen of Herbs". Tulsi has been valued for centuries for its diverse therapeutic properties and cultural significance. Historically, it has been used in Indian households not only for religious rituals, but also for treating ailments ranging from respiratory disorders to digestive issues. Scientifically, this plant is famous for its rich phytochemical composition, including eugenol, ursolic acid, rosmarinic acid, and flavonoids,

which contribute to its potent antioxidant, anti-inflammatory, and antimicrobial effects (Pattanayak et al., 2010; Singh et al., 2019). Research has shown that this plant plays a crucial role in stress management, immune system enhancement, and cardiovascular health improvement medicine. Additionally, its adaptogenic properties make it a natural solution for reducing anxiety and improving overall health. Tulsi has gained recognition in global pharmacological studies since modern science

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continues to explore plant-based medicines. Its applications extend beyond traditional medicine, greatly influencing contemporary fields such as nutraceuticals, cosmetics, and alternative healthcare (Gupta & Misra, 2020; Sharma et al., 2022). This paper aims to explore the historical significance, chemical composition, pharmacological properties, and modern applications of Tulsi, bridging ancient wisdom with scientific evidence for highlighting its immense potential in healthcare.

Historical Significance of Tulsi

Tulsi has always held immense historical and cultural significance in Indian history. Ayurvedic and religious traditions highlight its importance throughout ancient texts, medicinal practices, and spiritual beliefs.

Tulsi in Ancient Texts and Ayurveda

Tulsi is extensively mentioned in Ayurvedic scriptures, including the Charaka Samhita (1000 BCE) and Sushruta Samhita, where it is described as an elixir of life with the ability to balance the body's doshas (Vata, Pitta, and Kapha) (Dash & Kashyap, 2020). It has been used to treat respiratory diseases, digestive disorders, and infections from Vedic period (Pattanayak et al., 2010).

Religious and Cultural Importance

In Hinduism, Tulsi is revered as a sacred plant, and it is associated with Lord Vishnu and Goddess Lakshmi. It is often grown in temple courtyards and homes as a symbol of purity and protection (Gupta & Singh, 2018). The Tulsi Vivah festival, celebrated in India, marks the ceremonial wedding of Tulsi with Lord Vishnu, highlighting the beginning of the Hindu wedding season (Bhattacharyya, 2017).

Tulsi in Traditional and Folk Medicine

Beyond India, Tulsi has been used in traditional Chinese medicine and Siddha medicine for its various properties (Kumar et al., 2019). In African and Caribbean cultures, Tulsi has historically been used to treat fevers and respiratory infections (Owolabi et al., 2018).

Tulsi in Historical Trade and Agriculture

During ancient times, Tulsi was an essential part of herbal trade routes across Asia and the Middle East. It was cultivated not only for its medicinal benefits, but also as an insect repellent and food preservative for a very long time (Sharma & Patel, 2021).

Botanical Description and Classification

Tulsi belongs to the Lamiaceae family, and is widely cultivated across tropical and subtropical regions around the world. India is one of the major producers of Tulsi. Uttar Pradesh, Tamil Nadu, and West Bengal contribute most, due to its religious and medicinal significance (Patra et al., 2016). In Southeast Asia, countries like Thailand and Indonesia cultivate Tulsi for traditional medicine (Singh et al., 2010). It is also grown in Nigeria, Kenya, and Ethiopia in Africa for its therapeutic properties (Owolabi et al., 2018). Additionally, Tulsi is found in Brazil, the Caribbean, and parts of Australia, where it is used in herbal remedies and teas (Hassan et al., 2017).

The plant is classified into three primary varieties: Krishna Tulsi (*Ocimum tenuiflorum* with purple leaves), Rama Tulsi (*Ocimum sanctum* with green leaves), and Vana Tulsi (*Ocimum gratissimum*, a wild variety) (Singh et al., 2010). Morphologically, Tulsi is an aromatic, perennial shrub with a height ranging from 30 to 60 cm (Patra et al., 2016). The plant features ovate leaves



with slightly serrated edges and purplish or green inflorescences, depending on the variety (Kumar et al., 2021). The phytochemical composition of Tulsi changes from one species to another. Krishna Tulsi is popular for its high eugenol content; whereas, Rama Tulsi contains more linalool, which contributes to its distinct aroma (Singh et al., 2002). Its adaptability to different soil and climate conditions makes it a resilient plant for medicinal and commercial cultivation (Pandey & Madhuri, 2010). The classification of Tulsi based on its biochemical constituents has been explored in various taxonomical studies, highlighting its significance in both traditional medicine and modern pharmacology (Sharma, 2018).

Health Benefits of Tulsi (*Ocimum sanctum*)

Tulsi has been extensively studied for its diverse medicinal properties. It is revered in Ayurveda and modern science for its potential in promoting overall health and well-being. Below is a detailed discussion of its health benefits, supported by references.

Adaptogenic and Stress-Relieving Properties

Tulsi is classified as an adaptogen since it helps the body adapt to stress and maintain homeostasis. It reduces physical, metabolic, and psychological stress by modulating cortisol levels.

Study Evidence: A clinical study by Cohen (2014) found that Tulsi supplementation significantly reduced stress, anxiety, and depression in individuals. As a result of which cognitive function and emotional well-being enhanced.

Mechanism: Active compounds, like eugenol and ocimunosides A and B regulate cortisol and help in maintaining neurotransmitter balance.

Anti-Inflammatory and Analgesic Effects

Tulsi exhibits potent anti-inflammatory properties by inhibiting inflammatory pathways, making it beneficial in managing conditions like arthritis, asthma, and inflammatory bowel disease (Patel et al., 2017; Verma & Singh, 2020).

Study Evidence: Singh et al. (2015) reported that Tulsi extracts significantly inhibited pro-inflammatory cytokines such as TNF- α and IL-6, reducing inflammation-related diseases.

Mechanism: Essential oils, like eugenol and beta-caryophyllene block COX-2 enzymes, similar to non-steroidal anti-inflammatory drugs (NSAIDs).

Antimicrobial and Antiviral Properties

Tulsi is an effective natural remedy for infections. It possesses strong antimicrobial activity against bacteria, fungi, and viruses, helping in improving overall health.

Study Evidence: Pandey et al. (2017) found that Tulsi essential oil exhibited antibacterial activity against *E. coli*, *Staphylococcus aureus*, and *Salmonella typhi*.

Mechanism: Tulsi contains phytochemicals, like ursolic acid and carvacrol. These compounds disrupt microbial cell membranes and inhibit viral replication.

Cardiovascular Protection

Regular consumption of Tulsi has been proven to improved heart health by reducing cholesterol, and hypertension.

Study Evidence: A study by Pattanayak et al. (2010) found that Tulsi reduced LDL cholesterol while increasing HDL levels in hyperlipidemic patients.



Mechanism: Flavonoids and polyphenols in the plant are known to reduce oxidative stress and inflammation in blood vessels, preventing atherosclerosis.

Blood Sugar Regulation and Diabetes Management

Tulsi plays a significant role in managing diabetes by lowering blood glucose levels and improving insulin sensitivity.

Study Evidence: A random trial by Mondal et al. (2009) found that patients with type 2 diabetes who consumed Tulsi leaves daily showed a 17% reduction in fasting blood glucose levels.

Mechanism: Tulsi stimulates insulin secretion, reduces glucose absorption in the intestine, and improves overall pancreatic beta- cell function.

Respiratory Health and Immunity Boosting

Tulsi has been used for centuries to treat respiratory disorders, like asthma, bronchitis, and sinusitis due to its expectorant and immunomodulatory effects.

Study Evidence: Bhattacharyya & Kumar (2019) observed that Tulsi extracts enhanced lung function and reduced bronchoconstriction in asthmatic patients.

Mechanism: The bioactive compounds, including camphor and cineole, clear mucus from airways and reduce inflammation. As a result, patients can breathe without much difficulty.

Anti-Cancer Properties

Tulsi is becoming well-known for its potential role in cancer prevention due to its ability to neutralize free radicals and induce apoptosis in cancer cells.

Study Evidence: A study by Singh et al. (2015) highlighted that its extract inhibited the growth of breast, liver, and lung cancer cells in vitro.

Mechanism: Tulsi contains rosmarinic acid and apigenin, which are crucial to suppress tumor growth and enhance detoxification enzymes.

Neuroprotective Effects

Tulsi supports brain health by protecting against neurodegenerative disorders like Alzheimer's and Parkinson's disease.

Study Evidence: Research by Cohen (2014) found that Tulsi improved memory retention and reduced oxidative damage in the brain.

Mechanism: Antioxidants like luteolin and vicenin protect neurons from amyloid plaque formation and oxidative stress.

Gastrointestinal Health

Tulsi has gastro-protective properties and aids in digestion, preventing ulcers, acid reflux, and indigestion.

Study Evidence: Pattanayak et al. (2010) found that Tulsi extracts reduced gastric ulcer severity by 20–30% in animal models.

Mechanism: Tulsi increases mucus production in the stomach lining, reducing acid-induced damage. Ultimately, improving the gastrointestinal health

Skin and Hair Health

Tulsi is widely used in skincare and hair care due to its antibacterial, anti-fungal, and antioxidant properties.



Study Evidence: Pandey et al. (2017) found that topical application of Tulsi reduced acne and fungal infections.

Mechanism: The presence of ursolic acid and linalool promotes collagen production and reduces scalp infections.

Scientific Studies and Validation

Scientific research on Tulsi has provided substantial evidence supporting its traditional medicinal uses. Several clinical trials and in- vitro studies validate its pharmacological effects:

Clinical Trials on Human Health: Studies have shown that Tulsi supplementation reduces stress, improves cognitive function, and supports immune health (Cohen, 2014). The adaptogenic properties of it are particularly significant in managing stress and promoting overall wellness (Cohen, M., "The effects of Tulsi on stress and cognitive function," *Journal of Herbal Medicine*, 2014).

Comparative Studies with Modern Medicine: Tulsi's anti- diabetic properties have been compared with standard hypoglycemic drugs, showing significant blood glucose-lowering effects (Mondal et al., 2009).

Antimicrobial Efficacy: Research highlights Tulsi's antibacterial and antiviral properties against pathogens like *E. coli*, *Salmonella typhi*, and *Staphylococcus aureus* (Pandey et al., 2017).

Cardio-protective Benefits: Studies have already shown that Tulsi contributes to cardiovascular health by improving lipid profiles and reducing oxidative stress. Pattanayak et al. (2010) found that regular Tulsi consumption significantly reduced levels of LDL cholesterol and triglycerides in test subjects while enhancing their body's ability to neutralise oxidative stress.

Standardisation and Challenges: While Tulsi is widely used in herbal medicine, issues such as optimal dosage standardisation and bioavailability remain challenges for its integration into mainstream pharmaceuticals.

Agricultural and Environmental Significance

Agricultural Significance

Growing Tulsi is a sustainable practice for farmers as it is adaptable to a wide range of soil types and climate which makes it a valuable crop. Its drought tolerance and ability to grow in marginal soils further enhance its suitability for organic farming. Chemical inputs during farming are minimised making it environment friendly. Moreover, by being naturally resistant to many pests, Tulsi reduces the need for synthetic pesticides and chemical fertilisers, thus promoting soil health and reducing chemical runoff into nearby water bodies (Sharma, 2018). Studies have shown that Tulsi's essential oils, particularly its volatile compounds, possess insect-repellent properties. Which can help mitigate pest infestations in surrounding crops, making it an excellent companion plant in agro-ecological systems for getting maximum yield (Ghosh & Banerjee, 2021).

Environmental Benefits

Tulsi contributes to environmental conservation in several ways. One of which is its ability to purify air. It is known to absorb harmful pollutants, such as nitrogen dioxide and carbon monoxide from the air and release oxygen; thus, significantly improving air quality in urban areas (Kumar & Gupta, 2020). Tulsi's ability to filter particulate matter and reduce air toxicity has made it a common feature in urban gardening initiatives for controlling air pollution (Sharma et al., 2017). In terms of its role in climate change mitigation, Tulsi has been observed to aid in carbon sequestration.



Research suggests that planting Tulsi can sequester carbon dioxide from the atmosphere, helping to reduce greenhouse gas concentrations and mitigate global warming (Sarkar et al., 2019). This is particularly valuable in urban and suburban environments, where the proliferation of green spaces can play a crucial role in combating climate change.

Commercial Applications

Tulsi's has a commercial potential in multiple industries, making it a valuable economic crop with widespread applications. **Herbal and Ayurvedic Products:** Tulsi is a key ingredient in herbal teas, essential oils, and Ayurvedic formulations. Many national and international companies market Tulsi-based supplements for immunity enhancement and stress relief (Pandey & Madhuri, 2010). **Pharmaceutical Industry:** Extracts from Tulsi are used in modern medicine for their antimicrobial and anti-inflammatory properties. Clinical research is supporting its role in managing diabetes, respiratory disorders, and cardiovascular health (Singh, Hoette, & Miller, 2002). **Cosmetic and Skincare Industry:** Tulsi-based face packs, creams, and hair care products are popular due to their antioxidant and antibacterial properties, promoting healthy skin and hair (Sharma, 2018). It is a million dollar industry in modern times. **Food and Beverage Industry:** Tulsi-infused beverages, herbal candies, and flavouring agents are gaining popularity due to their health benefits. Tulsi is also used in organic cooking and dietary supplements owing to its enormous health benefits (Pandey & Madhuri, 2010). **Aromatherapy and Wellness:** Tulsi essential oil is widely used in aromatherapy for its calming effects. Tulsi-based incense sticks and air purifiers contribute to a holistic living environment during aromatherapy sessions (Singh, Hoette, & Miller, 2002). **Economic**

Impact: With increasing global demand for herbal and organic products, Tulsi cultivation offers economic opportunities for farmers. Large-scale Tulsi farming is supported by governments and private industries promoting herbal exports (Sharma, 2018).

Challenges and Future Prospects

Despite its numerous benefits, Tulsi cultivation and commercialisation face several challenges even in these modern times. One of the major concerns is the lack of standardisation in herbal medicine, leading to inconsistencies in the quality and efficacy of Tulsi-based products (Sharma, 2018). The absence of universally accepted guidelines for processing and dosage remains a limitation in integrating Tulsi into mainstream healthcare practices (Kumar & Gupta, 2020). Another challenge is the impact of climate change on Tulsi cultivation. Variations in temperature, rainfall, and soil conditions can affect the yield and potency of bioactive compounds in Tulsi, necessitating further research in adaptive farming techniques (Pandey & Madhuri, 2010). Additionally, future projects should focus on genetic research to enhance Tulsi's medicinal properties through selective breeding (Sharma et al., 2020). Biotechnology applications, such as tissue culture and genetic modification, could play a role in increasing the yield and potency of medicinal compounds (Singh, Hoette, & Miller, 2002). Expanding clinical research on Tulsi's pharmacological benefits could facilitate its acceptance as a complementary therapy in modern medicine (Kumar & Gupta, 2020). Government initiatives and funding for sustainable cultivation practices and market expansion can further boost the global demand for Tulsi (Singh et al., 2021). Strengthening global supply chains and promoting Tulsi-based products in international markets will



help in maximising its economic potential (Sharma, 2018).

CONCLUSION

Tulsi is a cornerstone of traditional medicine and a promising candidate for modern healthcare applications (Patel et al., 2022). Its diverse medicinal, agricultural, and commercial benefits highlight its importance as a crop (Sharma & Gupta, 2021). However, addressing standardisation issues, climate resilience, and large-scale production challenges is vital to maximise its potential. Future research should emphasise scientific validation and sustainable cultivation to integrate Tulsi more effectively into global wellness markets. This article concludes that the increasing recognition of Tulsi in the pharmaceutical, agricultural, and health sector will continue to expand in future as well.

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