eISSN 2581-8996
ONLINE
THE INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED (REFEREED) JOURNAL
Volume 07, Issue 02, July 2024

Phytochemical & Medicinal Properties of Tulsi Plant (Ocimum Sanctum)

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Received: 20 July 2024, Accepted: 28 July 2024, Published with Peer Reviewed on line: 31 July 2024

Abstract

Natural herbs have long been used in countries that are developing all throughout the world, including India. One such plant that symbolises everything wonderful about nature is basil (Ocimum basilicum Linn.), whose leaves have been used for centuries as a home cure for a variety of human diseases. Herbal extracts have demonstrated great promise as psychotherapeutics and psychiatric medications in a number of investigations. Tulsi, a plant native to the Indian subcontinent that is widely utilised in Siddha and Ayurvedic medicine, is one example of a herbal remedy. Although clinical effectiveness and safety investigations are still under progress, in-vitro research have been conducted to ascertain the adaptogenic, anti- inflammatory, cardioprotective, antibacterial, and immunomodulatory properties. All these medicinal properties are all around acknowledged and respected by present day science. Tulsi is the herb that fixes the humankind from all chances normally in the present shallow not very great way of life.

Keywords: Natural herb, Medicinal Properties, Ayurveda, 'Secret of Immortality.

Introduction

The Tulsi plant is cherished in the Culture of India for its sacred place and is said to be that it provides wealth and peace to the mind in homes. It is rightly called 'The Queen of Herbs' in Ayurveda, Tulsi is an effective plant valued for its propensity for flexibility and potential health benefits. In India, Tulsi leaves, commonly mentioned as holy basil in English [1], [2]. It is valued for their healing and magical qualities. In Indian medicinal system called Ayurveda, this fragrant member of the herb family is referred to as a 'Secret of Immortality'. Indian tradition has a high impact on the medicinal plant for the drug. Biochemical compounds present in the plants are effective, have no side effect and have a low cost [2]

Tulsi leaves are grown all over southeast Asia and are thought to provide several health benefits, particularly enhancing immunity curing breathing issues. It is employed in the treatment of various disease such as antimicrobial infection, antifungal, anticancer, arthritis, chronic fever, antifertility, eye disease, hepatoprotective, antispasmodic, and analgesic, antiemetic, cardio protective [3]. This medicinal herb has also been shown to reduce blood glucosides, making it an effective treatment of diabetes [4].

THE ORIGIN OF THE LOCATION

Tulsi plant may thrive up to the height of 1800 feet above the sea level as well as is found thriving from Himalayas to Andaman and Nicobar Island. Among various regions, it may be found in Arabian countries, West Africa, Malaysia, and Australia [5]. One of the most revered and holy herbs for most

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healing and restorative purposes. It is mostly found throughout India. The revered, widely-grown Tulsi plant grows in practically every region of the world with oist soil, having originated in its natural state as Vana Tulsi. About 50 to 150 species of plants and shrubs from Asia's tropical regions belong to the ocimum genus [6]. The traditional way for growth of this plant is by seeds. The incendiary oil of Tulsi is now under treatment.

HISTORICAL PERSPECTIVES OF TULSI PLANT-

Plants have traditionally been used as medicines. Plants were utilised as medicine among the Chinese since 4000-5000 B.C [3]. According to Rigveda, Plants were used as medicines between 3500 and 1600 B.C. A comprehensive inquiry regarding the medicinal qualities of plants was carried out by implementing the principles of Ayurveda [6]. The Tulsi plant is said to offer several therapeutic benefits in the Greek, Roman, Unani, and Ayurvedic medical systems in addition to the Siddha and Ayurveda. Indian medicinal plants have been successfully used in traditional medical systems to treat a wide range of illnesses, including bronchial asthma, chronic fever, colds, coughs etc.

Hindu mythology attributes sacred trees to Tulsi. It is sometimes referred to as the Holy Basil and is a type of basil. It holds great significance in Hindu mythology as the goddess who is Lord Vishnu's spouse [7]. The marriage of Tulsi to Lord Vishnu is celebrated as a full event that also heralds the beginning of the marriage season. Ocimum sanctum is referred to as Tulsi in Sanskrit and Holy basil in English. Tulsi is described by Padmapurana and Tulsi Kavacham as a life-protector that is with people from conception to death. Ocimum sanctum is a perennial scented plant. Most people refer to it as Tulsi. It is also known as Vishnu priya, Divya in Sanskrit [8]. The beneficial ethics of this multibranched annual medicinal plant are broadly respected by Hindus of India. This plant is beloved to gardeners and temple visitors everywhere.

BIOLOGICAL SOURCES OF TULSI PLANT

The scientific name of Tulsi plant is ocimum sanctum. It is a member of the Lamiaceae family and genus Ocimum [9], [10]. The genus Ocimum sanctum Linn. (Labiateae or Lamiaceae) comprises 30 species which are found in tropical and subtropical regions. The genus Ocimum contains over 160 species, which are widely distributed throughout the world's warmer climates. This species has a long history as culinary herbs, thanks to its foliage adding a distinctive flavor to many foods [11]. Known important species of the genus Ocimum with medicinal properties that grow throughout the world include Ocimum sanctum, Ocimum gratissimum (Ram tulsi), Ocimum canum (dulal tulsi), Ocimum basilicum (Ban Tulsi), Ocimum killimandscharicum, Ocimum americanum, Ocimum camphor, and Ocimum miranthum [12].

CULTIVATION OF TULSI PLANT

Although Ocimum is the species most commonly used for culinary and ornamental purposes, other species are also cultivated. In order to obtain essential oils from the blooming tops of this herb, it is harvested at full bloom . Basil grows best in hot, dry climates, although it is quite sensitive to cold. It grows best on well-drained soil with a pH between 5.5 and 6.5, which is somewhat acidic. It can grow properly at a minimum temperature of 17 °C and a high temperature of η9.β °C. A 94% relative humidity is needed. Due to the extremely cold climates in northern Europe, Canada, the northern states of the United States, and the south-island of New Zealand, Ocimum gratissimum is grown in

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greenhouses before being transplanted in late spring or early summer. Ocimum gratissimum is farmed commercially by gourmet cooks and home gardeners. The production of foliage on a stem closes when it bears flowers and turns woody. Essential oil production is falling [13]. A basil grower can stop this from happening by pinching off any flower stalks before they reach full maturity.

BOTANICAL DESCRIPTION OF TULSI PLANT

When fully grown, the Tulsi plant can reach heights of 30 to 60 cm and has a hairy stem. It is a multibranched subshrub that is upright. Tulsi leaves have a simple petiole, green and purple hue, and an oval blade that can grow up to 5 cm in length with a little toothed edge . The flowers of Tulsi are likewise purple to reddish in colour and grow in small, dense clusters on cylindrical spikes. Tulsi fruits are tiny, and the seeds range in colour from yellow to crimson.

There are three common kinds of Tulsi :

1. Shyama, is also known as Krishna Tulsi, which has purple leaves.
2. Shri Tulsi, also known as Rama Tulsi, is a plant with green leaves that is frequently used in worship.
3. Forest Tulsi, or Vana Tulsi.

TAXONOMICAL CLASSIFICATION OF TULSI KINGDOM

In the context of taxonomy, plants are grouped into phyla, divisions, super divisions, subkingdoms, and kingdoms. This leads to the designation of Tulsi, which is often referred to the ‘Queen of Herbs’ under a specific title . The species and genus of Tulsi are differentiated easily because to its unique designation. Lamiales and Lamiaceae family includes Tulsi. The brief classification is given as under :

Kingdom	Plantae
Sub kingdom	Tracheobionta
Super division	Spermatopta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Lamiales
Family	Lamiaceae
Genus	Ocimum
Species	O.Sanctum

STRUCTURE OF TULSI:

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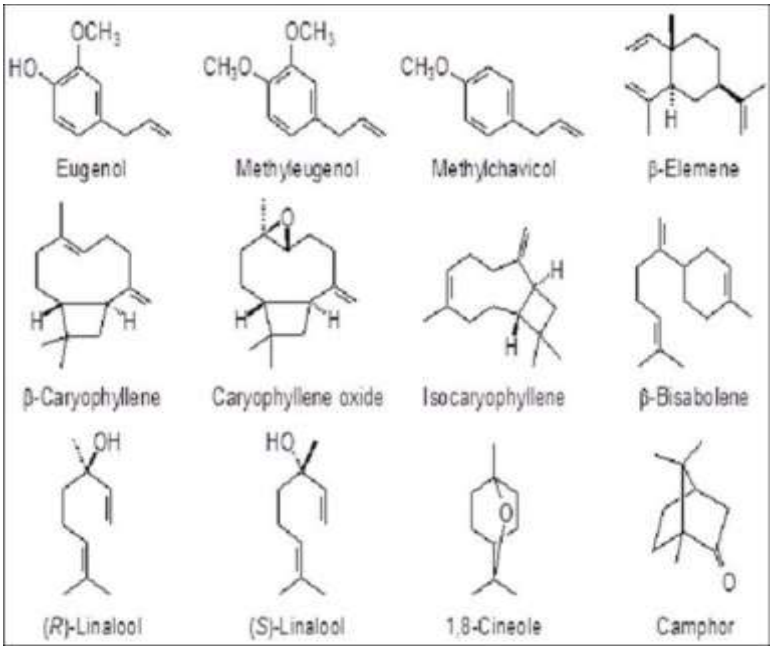
Ocimum sanctum is rigid, much furcated shrub with the height of 30-60cm on maturity. It has 5cm long simple, opposite, aromatic, elliptical, obtuse, dentate margin leaves. Flowers are elongated raceme and purplish in round whorl. The shade of the seeds are radish yellow and berry are little in size [2].

PHYTOCHEMISTRY IN TULSI PLANT

The chemical makeup of Ocimum sanctum is immensely webbed. It contains numerous nutriments and other natural dynamic mixes. O. sanctum has a very complex chemical makeup that includes a wide range of nutrients and other biologically active substances, the amounts of which can differ significantly between strains and even between plants growing in the same area .

O. sanctum contains methyl eugenol, ß-caryophyllene, methyl eugenol, €-

caryophyllene, eugenol and, ß-element, methyl chavicol, and linalool from India; ß-bisabolene, 1,8-cineole, and methyl chavicol from Poland; methyl eugenol and iso caryophyllene from Nigeria; eugenol, ß-caryophyllene, and caryophyllene oxide from Northeastern Brazil; eugenol, ß-element, and ß-caryophyllene from Cuba; methyl chavicol, camphor, and ß-caryophyllene from Australia [3]. O. gratissimum is a well-known plant utilised in Indian herbal medicine in other species.The plant and its oil contain diverse phytochemicals, including tannins, flavonoids, eugenol, caryophyllenes, carvacrol, linalool, camphor, and cinnamyl acetate, among others. Anthocyanin is the chemical, present in the leaves of Shyama Tulsi, due to which the colour of its leaves is purple.



The Tulsi plant is a rich repository of diverse phytochemicals, which vary across its different parts. The following table shows ocimum sanctum's phytochemical compositions [17]:

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Part of the plant	Phytochemicals
Leaf	Flavonoids, alknoids, saponins, tannins, phenols, anthocynins, terpenoids, steroils.
Stem	Phenols, saponins, flavonoids, triterpenoids, tannins.
Seeds	Fatty acids, sitosterol.
Whole plant	Flavonoids, alkanoids, saponins, tannins, phenols, anthocynins, triterpenoids.

MEDICINAL PROPERTIES OF TULSI PLANT

Ocimum Sanctum have a have several pharmacological activities and medicinal property, according to this it is effective in the treatment of a number of diseases. It has long been used to treat human illnesses. It is also a source of aroma compounds and essential oils containing biologically active constituents that possess insecticidal and nematocidal properties.

An overview of the pharmacological characteristics of ocimum sanctum is given in following table [14].

Part of the plant	Activity
Leaves	Anti stress, anti-chronic, anti-hypolipidemic, antioxidant, anthelmintic, anti-malarial activity (against plasmodium vivex), antifungal (against ring worm and also skin diseases), anti-fertility activity, anti-cancer (carcinogenic), antiviral activity.
Root	Deception of root act as a diaphoretic in malarial fever, anti- larvicidal (against to mosquitoes), antifungal (aspergillus Niger).
Flower	Antispasmodic agent (as smooth muscle relaxant).
Stem	Genitourinary system disorders.
Seeds	Reduced blood and urinary uric acid level in albino rabbits.
Whole Plant	Sugars (xylose and polysaccharides).

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PHARMACOLOGICAL ACTIVITIES OF TULSI

1. **Anticancer activity***:* In Ayurveda, a variety of plants are used as a source of antibacterial and antitumor effects . It is indicated that mice with solid Sarcoma-180 lived longer and the size of tumor cells can be reduced by the ethanoic extract of Ocimum sanctum [15]. Some of the other reports showed the same abstract with the mice in taking 200 mg/kg of the Tulsi extract orally and showing a reducing factor in the volume of tumor, increase in the weight of the body and survival rate. Tulsi has an ability to protect the DNA of the body from harmful radiations.

2. **Antidiabetic activity:** - It has been demonstrated that Tulsi holds remarkable antidiabetic characteristics. An antidiabetic characteristics of O. tenuiflorum hydroalcoholic extract against rats which forced to acquire diabetes using the streptozotocin and nicotinamide. Decoction prepared with various parts of plant lowers the blood sugar level.

3. **Antilipidemic activity**: - Now a days, hyperlipidaemia, atherosclerosis, and similar issues are life-threatening illnesses. Rats suffering from chronic hyperlipidemia due to triton WR1339 have reduced amount of total cholesterol, triglycerides and LDL cholesterol after being subjected to an aqueous extract of Oregano basilicum. According to Rabbit research when 1%-2% of fresh leaves of Tulsi are added to the daily diet for 28 days, it reduces the maximum fat.

4. **Antibacterial activity**: - Antibacterial activity of Ocimum sanctum in the aqueous, alcoholic, chloroform extract form and oil obtained from its leaves were studied against E. coli, P. aeruginosa, S. typhimurium and S. aureus. Gram positive and Gram-negative infectious bacteria have been found to be equally prone to the extracted product of O. sanctum. The essential oil obtained from the fresh Tulsi leaves is found to be more antibacterial than the oil which is extracted from the dried leaves of Tulsi which is opposite for fungi [16].

5. **Eye Disease**: - The juice of Ocimum sanctum leaf and triphala is present in the ayurvedic eye drop which is the best remedy for glaucoma, severe conjunctivitis, and other sensitive eye disorder. It is rightly said that when 3 drops of Tulsi oil and honey are used in the regular basis which is helpful in improving the vision.

6. **Anti fertility activity**: - In benzene and petroleum ether, the extract of Tulsi leaves shown to have antifertility aspects of 80% and 60% respectively in the female rats. According to some reports both Ayurvedic doctors and native women of Kerela used Tulsi leaves for its antifertility properties. Ursolic acid present in the leaves of Tulsi is responsible for antifertility activity [17]. The effect of this compound is attributed to its anti-estrogenic behaviour, which may be responsible for the spermatogenesis arrest in men and the impediment of ovum implantation in females . This component may verify to be an effective anti-fertility drug without any worse side effect. Tulsi leaves inhibit male sertoli cell activity, which lowers spermatogenesis.

7. **Mosquitocidal activity**: - Mosquitocidal activity of Tulsi was investigated using its eugenol and triglyceride (isolated from Tulsi's hexane extract) on fourth instars Aedes aegypti larvae. When seeds of Tulsi placed in water, it percolated within one hour, a mucilaginous substance (polysaccharides) and larvae which came in contact with seeds became firmly attached to it and died due to drowning of larvae [10].

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Volume 07, Issue 02, July 2024

8. **Antiallergic and Immunomodulator effects**: – Essential oil of Tulsi was found to have anti-allergic properties. When administered to laboratory animals, the compound was found to inhibit mast cell degranulation and histamine release in the presence of allergen. These studies reveal the potential role of Ocimum sanctum extracts in the management of immunological disorders including allergies and asthma.

9. **TULSI AS AN AYURVEDIC MEDICINE**

In the ancient Ayurvedic classic Charaka Samhita, and is distinguished by its potent flavour and pungent perfume. It is considered to be a kind of "elixir of life" and is thought to extend life .

In Ayurvedic treatments, Tulsi extract is used for normal colds, heart sickness, headaches, stomach ache, inflammation, poisonings of many kinds, and malaria. Traditionally, Tulsi is taken in multiple forms that includes fresh leaves, dry powder, herbal tea or by mixing with ghee or honey [12]. The essential oil of Tulsi is widely used in medical site and herbal cosmetics which is prepared Karpoor Tulsi. On combining Tulsi leaves with stored grain, which has been used for ages to protect from insects. Due to its significant herbicides level (1 hydro oxygen, 2 methoxy-4 allylbenzene), a variety of experiments show that like Tulsi, many traditional medications may be a COX-2 inhibitor [13]. Tulsi can also be taken as raw leaves after washing them, which relaxes the mind and provide eternal peace by curing various diseases. Ayurvedic treatments for common colds, headaches, stomach issues, inflammation, heart problems, several types of poisoning, and malaria use its extracts [14].

All Ayurvedic herbs are defined by their Ayurvedic properties [15], these properties include:

- Categorized according to: easily digestible or difficult to digest: Guna
- What is it taste? sweet, sour, salty, pungent, bitter and astringent: Rasa
- Process of digestion, metabolism and assimilation: Vipaka
- How strong is the effect of the herb on the stomach: Virya
- What action in the body does the food stimulate: Karma

Each Herb is described in the ancient text this way to point the way to the person so they understand the effect the herb will have on the particular body type and what is to be

expected from the herb.

Properties and Action:

Rasa: Katu, Tikta, Kasaya

Guna: Laghu, Ruksa, Tikshna¸ Virya: Usna

Vipaka: Katu

CURRENT RESEARCH TRENDS ON TULSI PLANT

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Volume 07, Issue 02, July 2024

In the recent years, traditional system of medicines have emerged as a potential source to cope with the growing rate of chronic, degenerative, environmental, lifestyle and stress related diseases. Traditionally, Basil has been used as whole herb to treat a good number of diseases. Prolonged use of certain antibacterial drugs can decrease the number of gut flora, which may have a negative impact on health. Antibiotics are sometime associated with adverse effects on the host including hypersensitivity, immuno suppression and allergic reactions. Research on Tulsi has focused on its potential in preventing and treating various diseases, including anxiety, depression, asthma, and diabetes. DNA barcoding has been used for species authentication and identification of contaminants and adulterants in herbal medicine products. The plant's phytochemicals, such as ursolic acid and eugenol, have been studied for their bioactive properties. Several other pharmacological effects, such as antitumor, hepatoprotective, anti-inflammatory (oral & topical), anti-ulcer, antimicrobial, anti-hyperlipidemic, and anti-viral activities, have also been attributed to ursolic acid. Additionally, Tulsi has been investigated for its antimicrobial and antiviral properties, including its efficacy against SARS-CoV-2. It has been proved to be of great importance to the health of the individuals and communities. This is the reservoir of potentially useful chemical compounds which could serve as newer leads and clues for modern drug design [16]. By this review, it is clear that so many studies have been accomplished in the field of medicine Further, clinical trials need to be carried out to ascertain the real effects of this “holy basil.”

FUTURE PROSPECTS OF TULSI PLANT

The future of Tulsi phytochemistry lies in unraveling the complex mechanisms of its bioactive compounds, such as ursolic acid, eugenol, and rosmarinic acid, and harnessing their potential for developing novel therapeutics. Emerging trends include the discovery of new phytochemicals, elucidation of their biosynthetic pathway[17], and engineering of Tulsi plants for enhanced production of desirable compounds. The traditional knowledge on herbal medicines has been passed from one generation to the next . However, chemical contents and composition of those medicinal plants are urgently needed to be explored for the betterment of an alternative form of natural medicines [18]. Fourier transform infrared spectroscopy (FTIR) is a physiochemical analytical technique which explores the chemical structure of the herbal plants along with its metabolites . It plays an important role in providing different band vibrations due to different functional groups of the herbal plants [19]. Advanced analytical techniques, like metabolomics and proteomics, will uncover the plant's intricate biochemical landscape, while cutting-edge biotechnological tools, such as CRISPR/Cas9 genome editing, will enable precision breeding for improved phytochemical profiles. These advancements will unlock the full potential of Tulsi phytochemistry, paving the way for the development of innovative, evidence-based nutraceuticals and pharmaceuticals. Several chemical class of compounds including phenolics, flavonoids, phenylpropanoids, neolignans, terpenoids, coumarins, fatty acid derivatives, essential oil and fixed oil have been reported from this herb . Tulsi (Ocimum sanctum) chosen for its anti- pollutant anti-oxidation and air-purifying properties making it an ideal ornamental shrub in the vicinity of the Taj Mahal. Now Tulsi is being used to help Taj Mahal to retain its pristine allure . All these restorative fixings make Tulsi an unquestionable requirement have for more and serene life. This little plant is unquestionably an excellent wellspring of restorative properties. Further studies are yet to be carried out to determine

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its exact mechanisms, dosage forms and to identify which type of population is more likely to avail the therapeutic benefits of Tulsi.

CONCLUSION-

In conclusion it is to be found that the various Ocimum species found are very much distinguished from each other. O. sanctum Linn. is a rich source of phytoconstituents and possesses an outstanding role in medicine. These phytochemicals are not essential for its survival but are of substantial importance to human community to carry out various protective functions in human body. O. sanctum has been shown to possess an excellent anticancer activity. This review has identified and compiled the traditional and chemical approach of utilizing the different parts of Tulsi plant. The literature will serve as a guideline for the researchers in future work related to the complex phytochemistry of the genus ocimum.

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