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An industrial cultivation of Tulsi (*Ocimum sanctum*) for medicinal use and rural empowerment

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Abstract

The main cause of global morbidity and mortality is lifestyle related chronic diseases, many of which can be cured by the use Ayurvedic medicines with its focus on healthy lifestyle practices and regular consumption of relaxing herbs. Herbs used within Ayurveda, tulsi (*Ocimum sanctum* Linn) is most excellent, has been proved for its beneficial effects. There is lot of literature showing that tulsi can address physical, chemical, metabolic and psychological stress through a unique combination of pharmacological actions. It has been found that tulsi can protect organs and tissues against chemical stress from industrial pollutants and heavy metals, and physical stress from prolonged physical exertion, ischemia, physical restraint and exposure to cold and excessive noise. Tulsi have broad-spectrum antimicrobial activities which includes activity against a range of human and animal pathogens. It has been also recommended for use as a hand sanitizer, mouthwash, water purifier, wound healing, preservation of food. Farming of tulsi has both religious and practical importance that connects the cultivator to the innovative powers of nature. Organic farming of tulsi can offers solutions for food security, rural poverty and hunger alleviation, prevention of environmental degradation and climate change. The use of tulsi in daily rituals is a witness to Ayurvedic intelligence and provides an example of ancient knowledge offering solutions to modern problems. Keeping above tulsi is requires to commercialize and increase area under organic cultivation, increase income and livelihood cultivators, prevention of soil & environment degradation. Use of tulsi in various ayurvedic medicines which makes Indian cultivators empowered by selling herbs and disease free society by using tulsi as medicines.

Keywords: Medicinal Value, Healthy Lifestyle, Empower Cultivators

Introduction

Tulsi is one of the chief sources of large number of drugs and medicine. It has very effective and remedial uses which is safe and effective, inexpensive in relation to its availability^[1]. Due to its medicinal values tulsi is important plant among other herbs known for the medicinal properties. It is belongs to the *Ocimum* genus and family Lamiaceae identified for their medicinal significance. There were two main varieties of tulsi have been identified i.e. black (Krishna tulsi) and green (Rama tulsi), both have similar chemical constituents^[2]. In a Sanskrit language tulsi is described as “matchless one”. The medicinal values of the tulsi properties have attributed not only in Ayurveda and Siddha but also in Greek, Roman and Unani systems of medicine^[3]. In China tulsi was used first the natural herbal preparations as medicines have therapeutic uses. In the old literatures tulsi has described 4000-5000 B.C and^[4]. Rigveda was the first referred and said to be written between 3500-1600 B.C^[5]. Tulsi (*Ocimum sanctum*), is believed the “Queen of Herbs”, the Legendary, “Incomparable One” is one of the holiest and highly respectable for most therapeutic and restorative herbs distributed mainly in the all regions of India^[6]. Tulsi a widely grown, sacred plant, it is found growing in environment having moist soil nearly all over the world^[7], which is original from its wild form (Vana tulsi). *Ocimum* genus have about 50 to 150 species of herbs and shrubs from the tropical regions of Asia^[8]. Tulsi has square stems, fragrant opposite leaves and whorled flower on spiked inflorescence^[9]. The essential oil of tulsi is extracted by steam distillation from the leaves and flavouring tops are used into foods, dental and oral products, in fragrances and in traditional rituals and medicines^[10, 11]. Extracted essential oils have also been shown to contain biologically active constituents that are insecticidal^[12], nematocidal^[13] and fungicidal^[14]. The chemical constituent in tulsi is essential oil which have methyl chavicol, eugenol linalool, camphor and methyl cinnamate. There are two minor components of the

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essential oil of sweet basils (*Ocimum basilicum*): Juvocimene I and II have been reported as potent juvenile hormone analogs [15]. With this background the main aim of present study was focused on evaluation of medicinal values of tulsi and its large scale cultivation in the field which will help in empowerment of farmers.



Fig 1: Rama Tulsi



Fig 2: Krishna Tulsi

Botany

Tulsi is a member of the family Lamiaceae (Labiatae) and is closely related to the common basil (*Ocimum basilicum*). It is an upright, 30-60 cm tall plant covered with soft hairs. The stems are square in transaction, and the leaves are opposite, elliptical-oblong with relatively long petioles and serrated leaf margins. The flowers appear in racemes arising in whorls on the terminal part of the stems and are labiate, bilaterally symmetrical and purplish in colour.

Chemistry

Ocimum sanctum (tulsi) has specific aromatic odour because of the presence of essential or volatile oil, mainly concentrated in the leaf. This aromatic volatile oil mainly contains phenols, terpenes and aldehydes. The oil extracted from seeds is called fixed oil and mainly composed of fatty acids. Besides oil, the plant also contains alkaloids, glycosides, saponins and tannins. The leaves contain ascorbic acid and carotene as well. The present day information about the chemical properties is based on the various studies that have been done in different parts of the world [16] and it is likely that chemical constituents may be varying due to edaphic and geographic factors [17].

Traditional Uses

Tulsi is also known as "the elixir of life" since it promotes longevity. Different parts of plant are used in Ayurveda and

Siddha Systems of Medicine for prevention and cure of many illnesses and everyday ailments like common cold, headache, cough, flu, earache, fever, colic pain, sore throat, bronchitis, asthma, hepatic diseases, malaria fever, as an antidote for snake bite and scorpion sting, flatulence, migraine headaches, fatigue, skin diseases, wound, insomnia, arthritis, digestive disorders, night blindness, diarrhoea and influenza. The leaves are good for nerves and to sharpen memory. Chewing of Tulsi leaves also cures ulcers and infections of mouth.

Use in Pharmacology

Pharmacological studies have revealed that animals treated with tulsi extract were useful for both physical and chemical stress reliever. A leaf extract has been acts as stimulant to release of ACTH from pituitary cells *in vitro* [18]. The evidence shows that the non-toxic nature of the tulsi plant and its extract, makes an excellent example of an adaptogenic medicinal plant.

Use in Health Benefits

Basil or tulsi has been used in oral care, giving relief from respiratory disorders, fever, asthma, lung disorders, heart diseases and stress. It is undoubtedly the most excellent medicinal herb ever known. In India tulsi has worshipped since thousands of year for its endless miraculous, medicinal values and it protects from many infections. Tulsi leaves added to drinking water or foodstuff which is able purify it and also kills germs present in it. If the tulsi plant kept in in house it can protect the full family from infections, like cough and cold, viral infections and also boosts the immune system. It can also protect from other infections such as viruses, bacteria, fungi and protozoa. Recent studies revealed that it is also helpful in inhibiting growth HIV and carcinogenic cells.

Use As Healing Power

Tulsi has lot of medicinal characteristics and it can be used as a nerve tonic and sharpen memory. It encourage for the elimination of the catarrhal matter and phlegm from the bronchial tube. Leaves of tulsi make stronger the stomach and encourage copious perspiration.

Use in Coughs

Tulsi has important component of many Ayurvedic cough syrups and expectorants. It helps in bronchitis and asthma. It relieves from cold and flu after chewing of leaves.

Use in Throat Infection

Tulsi leaves taken in water boiled for few minutes and filter this extract is very beneficial in sore/painful throat and it is also use as gargle.

Use in Respiratory Disorder

Tulsi has been use for the treatment of respiratory disorder. Green leaves juice mixed with honey and ginger are very effective in bronchial asthma, cough, cold and influenza. If it is added with cloves and common salt also gives instant relief in influenza.

Use in Fever & Common Cold

Tulsi leaves are specific for many fevers in the rainy season; when malaria and dengue fever are widely prevalent. Tender leaves, boiled with tea, act as preventive against these diseases. In case of acute fevers, a decoction of the leaves boiled with powdered cardamom in half a litre of water and mixed with sugar and milk brings down the temperature. The

juice of tulsi leaves can be used to bring down fever. Tulsi leaves extract in fresh water should be given to children, it is every effective in bringing down the temperature.

Use in Kidney Stone

Tulsi has effect on the kidney to strengthen their functioning. Tulsi juice and honey can able remove renal stone in the kidney, if taken regularly for six months it will expel them via the urinary tract.

Use in Heart Disorder

Tulsi has a beneficial effect in heart disease. It also reduces the level of cholesterol in blood.

Use in Children's Ailments

Tulsi leaves juice uses in general pediatric disorders such as cold cough, fever, diarrhea and vomiting. Leaves of tulsi used to hasten pustules of chicken pox delay their appearance.

Uses in Stress

Tulsi leaves are considered as an 'adaptogen' or anti-stress agent. In the recent studies conducted which reveals that the leaves give significant defense against stress. If a healthy persons chew 10-12 leaves of tulsi, twice or thrice of a day, to prevent stress. It purifies blood and helps to prevent several common ailments.

Uses in Mouth Infections

The leaves of tulsi are quite useful for the healing of ulcer and infections in the mouth. A few leaves chewed will cure these symptoms.

Use in Skin Disorders

Tulsi leaves extract applied locally, beneficial for the treatment of ringworm and other skin disorders. It has also been successfully applied and found that tulsi is very helpful in the treatment of leucoderma skin disease.

Use in Teeth Disorder

Tulsi herb is useful in teeth disorders. Sun dried and powdered leaves can use for brushing of the teeth. Its toothpaste can be prepared the powder mixed with mustered. This is very good for maintaining dental health, counteracting bad breath and for massaging the gums. It is also useful in pyorrhoea and other teeth disorders.

Use in Headaches

Tulsi is an excellent drug for taking away headache. Decoction of tulsi leaves is help to remove this disorder.

Use in Clinical and Pharmacological Studies

All over the world scientific research is receiving thrust to assess the pharmacological actions, side effects and therapeutic uses of tulsi against unlike diseases. On the basis of different investigations and clinical trials, the various pharmacological activities or medicinal properties of tulsi have been reported.

Uses in Insect Bites

Tulsi is a prophylactic and curative for insect stings or bites. A fresh tulsi leaves juice taken a teaspoonful repeated after a few hours are helpful in this case and fresh juice can also be applied to the affected area to get relieve from stinging pain. A paste of fresh roots of tulsi is also effective in case of bites of insects and leeches.

Most of the studies have established that tulsi improves resistance to different types of stress. Increased resistance has been demonstrated in animal models against stressors such as behavioural despair, induced gastric ulcers, and exposure to hepato-toxins^[19, 20].

There were two studies have resulted that an ethanolic extract of tulsi acts to prevent endocrine stress responses to noise induced stress^[21, 22]. One of these studies has showed that elevation of plasma corticosterone levels induced by loud noise was prevented in rats treated with tulsi extract^[21]. The other studies have found that it prevents several noise induced stress responses in the rat, namely an increase in plasma corticosterone level, leucopenia and enhanced neutrophil function^[22].

Thus a variety of studies using different animal models of stress suggest that basil can ameliorate the physiological responses to stress, thus in effect enabling the body to better cope with stress without becoming 'stressed out'.

Use in Antioxidant Activity

A number of studies have demonstrated, either directly or indirectly, that tulsi good antioxidant activity. Tulsi demonstrated protective effects against copper sulphate toxicity in rats^[23]. Copper sulphate caused the development of free hydroxyl radicals and subsequent increased lipid peroxidation and led to rises in levels of antioxidant enzymes such as superoxide dismutase and catalase. Administration of tulsi restored the various parameters to near normal values.

Use in Anti-Cancer Activity

The anticancer activity of tulsi has been proved and cited by several investigators^[24]. The alcoholic extract of leaves of tulsi has a modulatory influence on carcinogen metabolizing enzymes such as cytochrome P 450, cytochrome b5, aryl hydrocarbon hydroxylase and glutathione transferase (GST), which are important in detoxification of carcinogens and mutagens. The anticancer activity of tulsi has been reported against human fibro-sarcoma cells culture, wherein AIE of this drug induced cytotoxicity at 50 mg/ml and above. Morphologically, the cells showed shrunken cytoplasm and condensed nuclei. The DNA was found to be fragmented on observant on in agar tulsi gel electrophoresis. It significantly decreased the incidence of benzo (a) pyrene induced neoplasia of fore stomach of mice and 3'-methyl-4-dimethylaminoazobenzene induced hepatomas in rats. The AIE of the leaves of tulsi was shown to have an inhibitory effect on chemically induced skin papillomas in mice^[25]. Topical treatment of tulsi leaf extract in 7,12- dimethylbenz (a) anthracene (DMBA) induced papilloma genesis significantly reduced the tumour incidence, average number of papillomas/mouse and cumulative number of papillomas in mice. Topical application of the extract significantly elevated reduced GSH content and GST activities. A similar activity was observed for eugenol, a flavonoid present in many plants, including Tulsi. Oral treatment of fresh leaves paste of Tulsi may have the ability to prevent the early events of DMBA induced buccal pouch carcinogenesis^[26]. Leaf extract of Tulsi blocks or suppresses the events associate with chemical carcinogenesis by inhibiting metabolic activation of the carcinogen. The anticancer activity of TULSI was observed in Swiss albino mice bearing Ehrlich ascites carcinoma (EAC) and S 180 tumours^[27]. The anti-carcinogenic properties have been evaluated in the experimental animals induced by different types of carcinogens. Tulsi leaves when fed to experimental rats with 600 mg/g diet for ten weeks,

significantly reduced the 3,4- benzo (a) pyrene [B(a)P] and 3'-methyl-4- dimethylaminoazobenzene (3'MeDAB) induced squamous cell carcinoma and hematoma incidences. The anti-cancer activity of Tulsi has also been reported from Philippines where juice of fresh leaves was applied on the skin of experimental mice thrice a week for 20-minutes along with tumor promoter agents (dimethylbenzanthracene as initiator and croton oil as promoter of cancer). No incidences of tumor were found in 20 weeks follow up period in tulsi treated group. The ethanolic extract of tulsi leaves of 400 and 800 mg/kg have found to modulate carcinogen metabolizing enzymes such as cytochrome P-450, cytochrome-b5 and aryl hydrocarbon hydroxylase of mice liver [28].

Use in Immuno-Modulating Activity

Pharmacological studies in rats have indicated that both aqueous and methanolic extracts of tulsi leaves stimulate humoral and cellular immunity. Increased humoral immune response was demonstrated by increased antibody titre in response to challenge with typhoid antigen, while raised cellular immunity was evidenced by increased lymphocyte count [29].

Use in Anti-Inflammatory

Methanol extract (500 mg/kg) and aqueous suspension of tulsi showed analgesic, antipyretic and anti-inflammatory effects in acute (carrageenan induced pedal oedema) and chronic (croton oil induced granuloma and exudate formation) inflammations in rats. The fixed oil and linolenic acid possess significant anti-inflammatory activity against PGE₂, leukotriene and arachidonic acid induced paw oedema in rats by virtue of their capacity to block both the cyclooxygenase and lipoxygenase pathways of arachidonic acid metabolism [30]. The aqueous and methanol suspension of tulsi has shown to inhibit acute as well as chronic inflammation in rats. This test was conducted by carrageenan induced paw edema, croton oil induced granuloma and exudates, at a dose of 500 mg/kg, bw/day. The oils extracted from fresh leaves (essential oil) and seeds (fixed oil) of tulsi have shown anti-inflammatory effects on experimental animal's hind paw edema induced by carrageenan, serotonin, histamine and prostaglandin-E-2. These experimental rats were administered with essential oil (200 mg/kg, bw), and fixed oil (0.1ml/kg, bw) before injection of phlogistic agents and was compared with standard drug flurbiprofen. It was noted that Tulsi extracts could significantly reduce the edema when compared with the saline treated control. However, its effect was less than the standard drug [31]. The mechanism of action of the anti-inflammatory effects of tulsi could be the cyclo-oxygenase and lipoxygenase pathways. In order to compare the anti-inflammatory effects of fixed oils of various species of *Ocimum* viz *O. sanctum*, *O. basilicum*, *O. americanum*, which possess varying proportions of unsaturated fatty acids (particularly linolenic acid) showed different response against phlogistic agent induced paw edema. *Ocimum basilicum* possess highest percentage of linolenic acid (21.0%) and offered maximum inhibition of paw edema (72.42%), *O. sanctum* fixed oil containing 16.63% linolenic acid provided 68.97% inhibition while *O. americanum* offered least paw edema inhibition. Fixed oil of tulsi can inhibit enhanced vascular permeability and leukocyte migration as evidenced by carrageenan induced inflammatory stimulus agent induced paw edema. *Ocimum basilicum* possess highest percentage of linolenic acid (21.0%) and offered maximum inhibition of paw edema (72.42%), *O. sanctum* fixed oil containing 16.63%

linolenic acid provided 68.97% inhibition while *O. americanum* offered least paw edema inhibition. Fixed oil of tulsi can inhibit enhanced vascular permeability and leukocyte migration as evidenced by carrageenan induced inflammatory stimulus [32].

Use in Antipyretic Activity

The antipyretic activity of tulsi fixed oil was evaluated by testing it against typhoid-paratyphoid A/B vaccine-induced pyrexia in rats. The oil on administration considerably reduced the febrile response indicating its antipyretic activity. At a dose of 3 ml/kg, the antipyretic activity of the oil was comparable to aspirin. Further, the fixed oil possessed prostaglandin inhibitory activity and the same could explain its antipyretic activity [33, 37].

Use in Antidiabetic Activity

Oral administration of tulsi extract led to marked lowering of blood sugar in normal, glucose fed hyperglycemic and streptozotocin-induced diabetic rats. A randomized, placebo-controlled, cross over single blind human trial indicated a significant decrease in fasting and postprandial blood glucose levels by 17.6% and 7.3%, respectively. Urine glucose levels showed a similar trend. Further, tulsi has aldose reductase activity, which may help in reducing the complications of diabetes such as cataract, retinopathy, etc [34]. Leaves of tulsi have been shown to possess hypoglycaemic effects in experimental animals [35]. Decoction prepared with various parts of plant lowers the blood sugar level. A study conducted on rats has suggested that constituent of *O. sanctum* leaf extracts have stimulatory effects on physiological pathways of insulin secretion [36]. Various studies have been performed on the antiglycemic properties of *Ocimum* but its mechanism of action has not been elucidated as yet. Study conducted with tulsi plus neem has suggested that this combination is better for the diabetic patients in lowering the sugar level [33].

Use in Antiarthritic Activity

Antiarthritic activity of tulsi fixed oil was evaluated against formaldehyde-induced arthritis in rats. The fixed oil significantly reduced the diameter of inflamed paw. On intraperitoneal administration of the fixed oil daily for 10 days, there was marked improvement in the arthritic conditions in rats. The antiarthritic effect at 3 ml/kg dose was comparable to aspirin at 100 mg/kg. The fixed oil inhibited carrageenan and inflammatory mediators (e.g., serotonin, histamine, bradykinin and PGE₂) induced inflammation. It is natural that the oil could inhibit any inflammatory response involving these mediators. The result suggests potentially useful antiarthritic activity of the inflammation models, including adjuvant as well as turpentine oil-induced joint oedema in rats [38].

Use in Anti Cataract Activity

Basil leaf was found to have both pro-phylactic action and be able to arrest the progress of cataract formation in animal models [39]. Oxidative damage by free radicals is believed to be the major cause of cataracts, and basil's anti-cataract effect is undoubtedly closely associated with its antioxidant activity.

Use in Anticoagulant Activity

Tulsi fixed oil (3 ml/kg, ip) prolonged blood clotting time and the response was comparable to that obtained with aspirin (100 mg/kg). The effect appears to be due to the anti-aggregator action of oil on platelets [41].

Conclusion

Current scientific review offers substantial evidence that tulsi protects against diseases and reduces stress; enhances stamina and endurance; increases the body's efficient use of oxygen; immune system; reduces inflammation; protects against radiation damage; lessens aging factors; supports the heart, lungs and liver; has antibiotic, antiviral and antifungal properties; enhances the efficacy of many other therapeutic treatments; and provides a rich supply of antioxidants and other nutrients. Overall, tulsi is a premier adaptogen, helping the body and mind to adapt and cope with a wide range of physical, emotional, chemical and infectious stresses, and restore disturbed physiological and psychological functions to a normal healthy state. This general vitality enhances and health promoting properties, in addition to it has many more specific therapeutic actions, likely account for much of the exceptionally broad range of Tulsi's traditional medical uses, and benefiting to the cultivators to enhance their income by commercializing tulsi.

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