

# Tulsi - *Ocimum sanctum*: A herb for all reasons

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## ABSTRACT

The predominant cause of global morbidity and mortality is lifestyle-related chronic diseases, many of which can be addressed through Ayurveda with its focus on healthy lifestyle practices and regular consumption of adaptogenic herbs. Of all the herbs used within Ayurveda, tulsi (*Ocimum sanctum* Linn) is preeminent, and scientific research is now confirming its beneficial effects. There is mounting evidence that tulsi can address physical, chemical, metabolic and psychological stress through a unique combination of pharmacological actions. Tulsi has been found to 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 has also been shown to counter metabolic stress through normalization of blood glucose, blood pressure and lipid levels, and psychological stress through positive effects on memory and cognitive function and through its anxiolytic and anti-depressant properties. Tulsi's broad-spectrum antimicrobial activity, which includes activity against a range of human and animal pathogens, suggests it can be used as a hand sanitizer, mouthwash and water purifier as well as in animal rearing, wound healing, the preservation of food stuffs and herbal raw materials and traveler's health. Cultivation of tulsi plants has both spiritual and practical significance that connects the grower to the creative powers of nature, and organic cultivation offers solutions for food security, rural poverty, hunger, environmental degradation and climate change. The use of tulsi in daily rituals is a testament to Ayurvedic wisdom and provides an example of ancient knowledge offering solutions to modern problems.

**Key words:** Adaptogen, Ayurveda, holy basil, lifestyle, *Ocimum sanctum*, stress, tulsi

## INTRODUCTION

### Diseases of modern life

Despite the many wonders of science and industry, modern life is fraught with stress. Mobile devices and the web have vastly increased the pace of life so that many people feel that they are now drowning in an ever-expanding ocean of data, while industrial agriculture has burdened us with increasing exposure to unhealthy processed and packaged food and a plethora of pesticides, food packaging materials

and other toxic industrial chemicals. Urban dwellers are also faced with increasing wealth inequality, social isolation, excessive noise, air, water and soil pollution and disconnection from nature. Thus, while industrialization has led to longer lifespans and vast increases in human populations, it is now recognized that the greatest causes of death and disease on the planet are preventable lifestyle-related chronic diseases.<sup>[1]</sup>

We are in the midst of a global pandemic of obesity, diabetes, cancer, dementia, depression and other chronic diseases caused by modern lifestyles and their associated lack of physical activity, high intake of sugar, fat, salt, alcohol and tobacco and exposure to a toxic cocktail of industrial chemicals. The solutions to this current health crisis are therefore more likely to be found in the homes and behaviors of individuals than in medical clinics, hospital or pharmacies.

### Ayurveda and lifestyle medicine

As a science of life and the world's oldest medical system, Ayurveda has a holistic approach to health and disease that focuses on preserving and promoting good health and preventing disease through healthy lifestyle practices. These practices include consumption of fresh, minimally processed foods, the use of Rasayanas (formulas) that

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eradicate ageing and disease, sophisticated detoxification practices and regular consumption of adaptogenic herbs that enhance the body's capacity to maintain balance in the midst of a variety of stressors.

Ayurveda's use of medicinal and culinary herbs draws upon India's incredible biodiversity with a variety that is unsurpassed by any medical system; yet, of all the herbs used, none has a status comparable to tulsi or holy basil (*Ocimum sanctum*).

### Tulsi: A potent adaptogen

Tulsi is an aromatic shrub in the basil family Lamiaceae (tribe ocimeae) that is thought to have originated in north central India and now grows native throughout the eastern world tropics.<sup>[2]</sup> Within Ayurveda, tulsi is known as "The Incomparable One," "Mother Medicine of Nature" and "The Queen of Herbs," and is revered as an "elixir of life" that is without equal for both its medicinal and spiritual properties.<sup>[3]</sup> Within India, tulsi has been adopted into spiritual rituals and lifestyle practices that provide a vast array of health benefits that are just beginning to be confirmed by modern science. This emerging science on tulsi, which reinforces ancient Ayurvedic wisdom, suggests that tulsi is a tonic for the body, mind and spirit that offers solutions to many modern day health problems.

Tulsi is perhaps one of the best examples of Ayurveda's holistic lifestyle approach to health. Tulsi tastes hot and bitter and is said to penetrate the deep tissues, dry tissue secretions and normalize kapha and vata. Daily consumption of tulsi is said to prevent disease, promote general health, wellbeing and longevity and assist in dealing with the stresses of daily life. Tulsi is also credited with giving luster to the complexion, sweetness to the voice and fostering beauty, intelligence, stamina and a calm emotional disposition.<sup>[3-6]</sup> In addition to these health-promoting properties, tulsi is recommended as a treatment for a range of conditions including anxiety, cough, asthma, diarrhea, fever, dysentery, arthritis, eye diseases, otalgia, indigestion, hiccups, vomiting, gastric, cardiac and genitourinary disorders, back pain, skin diseases, ringworm, insect, snake and scorpion bites and malaria.<sup>[3,5-7]</sup>

Considered as a potent adaptogen, tulsi has a unique combination of pharmacological actions that promote wellbeing and resilience. While the concept of an "adaptogen," or herb that helps with the adaptation to stress and the promotion of homeostasis, is not widely used in Western medicine, Western science has revealed that tulsi does indeed possess many pharmacological actions that fulfill this purpose.

The medicinal properties of tulsi have been studied in hundreds of scientific studies including *in vitro*, animal

and human experiments. These studies reveal that tulsi has a unique combination of actions that include: Antimicrobial (including antibacterial, antiviral, antifungal, antiprotozoal, antimalarial, anthelmintic), mosquito repellent, anti-diarrheal, anti-oxidant, anti-cataract, anti-inflammatory, chemopreventive, radioprotective, 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 and anti-coagulant activities.<sup>[4-7]</sup> These pharmacological actions help the body and mind cope with a wide range of chemical, physical, infectious and emotional stresses and restore physiological and psychological function.

### Protection and detoxification

Many of the physiological benefits of tulsi can be attributed to its ability to assist with the body's internal housekeeping and protection of the body from toxin-induced damage. These functions are often attributed to tulsi's high content of phenolic compounds and anti-oxidant properties, with Krishna tulsi (black/purple variety) having a higher phenolic content and anti-oxidant capacity than white Vana (wild) tulsi.<sup>[8]</sup>

Laboratory studies have shown that tulsi protects against toxic chemical-induced injury by increasing the body's levels of anti-oxidant molecules such as glutathione and enhancing the activity of anti-oxidant enzymes such as superoxide dismutase and catalase, which protect cellular organelles and membranes by mopping up damaging free radicals caused by lack of oxygen<sup>[9]</sup> and other toxic agents.<sup>[10,11]</sup>

Tulsi also helps to prevent cancers caused by toxic compounds by reducing DNA damage<sup>[12]</sup> and inducing apoptosis in precancerous and cancerous cells, thereby reducing the growth of experimental tumors and enhancing survival.<sup>[13,14]</sup> Furthermore, tulsi not only protects against the damage caused by toxic compounds, but also enables the body to more effectively transform and eliminate them by enhancing the activity of liver detoxification enzymes such as the cytochrome P450 enzymes, which deactivates toxic chemicals and enables them to be safely excreted.<sup>[15]</sup>

While these actions are vitally important for protecting against natural toxins produced within the body or by animals or plants, they are perhaps even more important in the modern age to protect against the vast range of pollutants, pesticides, pharmaceuticals, heavy metals, radiation and other industrial toxicants created from human activity.

### Toxicant stress: Chemicals, heavy metals and radiation

The ability of tulsi to protect against the damaging effects of various toxicants has been documented in numerous experimental studies. These studies attest to the ability of tulsi to prevent liver, kidney and brain injury by protecting against the genetic, immune and cellular damage caused by pesticides, pharmaceuticals and industrial chemicals. Thus, tulsi has been shown to protect against the toxic effects of industrial chemicals such as butylparaben,<sup>[16]</sup> carbon tetrachloride,<sup>[17]</sup> copper sulfate<sup>[18]</sup> and ethanol,<sup>[19]</sup> and common pesticides such as rogor,<sup>[20]</sup> chlorpyrifos,<sup>[21]</sup> endosulfan<sup>[22]</sup> and lindane.<sup>[23]</sup> Tulsi has also been shown to protect against the toxic effects of many pharmaceuticals drugs including acetaminophen,<sup>[24]</sup> meloxicam,<sup>[25]</sup> paracetamol,<sup>[26]</sup> haloperidol<sup>[27]</sup> and anti-tubercular drugs.<sup>[28]</sup>

In addition to protecting against toxic chemicals, tulsi has also been shown to protect against the toxic effects of heavy metals such as lead, arsenic, cadmium, chromium and mercury<sup>[29-31]</sup> and the toxic effects of radiation.<sup>[32-35]</sup> Tulsi exerts its radio-protective effects by scavenging free radicals and reducing the oxidative cellular and chromosomal damage induced by radiation,<sup>[33,36-38]</sup> thereby reducing organ damage and enhancing postradiation survival in experimental animals.<sup>[39-41]</sup>

### Physical stress

The actions that protect against the toxic effects of chemicals and radiation also help to address the toxic effects of many physical stressors. Prolonged physical exertion, physical restraint, exposure to cold and excessive noise disturb homeostasis by inducing physiological and metabolic stress. When the capacity to adapt to these stressors is exceeded, maladaptation occurs resulting in damage to biochemical pathways, organ function and health. Through enhancing various cellular and physiological adaptive functions, adaptogenic herbs such as tulsi are able to protect against this damage.

Studies using forced-swimming, restraint and cold-exposure stress in laboratory animals have shown that tulsi enhances aerobic metabolism, improves swimming time, reduces oxidative tissue damage and normalizes many physiological and biochemical parameters caused by physical stressors. Similarly, experimental studies have shown that tulsi helps reduce the effects of acute and chronic noise-induced stress in experimental animals, with enhancement of neurotransmitter and oxidative stress levels in discrete brain regions along with improved immune, ECG and corticosteroid responses.<sup>[42-45]</sup>

### Metabolic stress

Metabolic stress due to poor diet, low physical activity and psychological stress is a prominent feature of modern

lifestyles and “metabolic syndrome” is estimated to affect as much as one-third of modern populations. Metabolic syndrome, also known as “prediabetes” or “Syndrome X,” includes the “deadly quartet” of centripetal obesity, hypertension, high cholesterol and poor glucose regulation and is associated with chronic inflammation and a greater risk of diabetes, heart disease and stroke. While the exact causes of metabolic syndrome are still being debated, there is evidence to suggest that tulsi can assist in dealing with many features of metabolic syndrome and their consequences.

Numerous test tube and animal experiments as well as human clinical trials have shown that tulsi has anti-diabetic activity. Studies using diabetic laboratory animals have shown that tulsi can reduce blood glucose, correct abnormal lipid profiles<sup>[46,47]</sup> and protect the liver and kidneys from the metabolic damage caused by high glucose levels.<sup>[48]</sup> Tulsi has also been shown to improve lipid profiles,<sup>[49,50]</sup> prevent weight gain, hyperglycemia, hyperinsulinemia, hypertriglyceridemia and insulin resistance,<sup>[51,52]</sup> and protect the organs and blood vessels from atherosclerosis<sup>[49,53]</sup> in laboratory animals fed high-fat diets. Similarly, in human clinical trials, tulsi has shown to decrease glucose levels, improve blood pressure and lipid profiles<sup>[54-56]</sup> and reduce many diabetic symptoms in patients with type 2 diabetes.<sup>[57]</sup>

The beneficial metabolic effects of tulsi are multiple and include protecting the liver, kidneys<sup>[49]</sup> and pancreatic islet cells from free radical damage;<sup>[58]</sup> enhancing liver bile acid synthesis<sup>[49]</sup> and reducing liver lipid synthesis;<sup>[52]</sup> enhancing insulin secretion<sup>[59]</sup> and action;<sup>[60]</sup> lowering cortisol levels;<sup>[61]</sup> and reducing inflammation. The anti-inflammatory action of tulsi, which has been observed in both acute and chronic inflammatory models in animals,<sup>[62-65]</sup> is attributed to tulsi’s eugenol and linoleic acid content and the inhibition of both the cyclooxygenase and the lipoxygenase pathways of arachidonic acid metabolism.<sup>[66,67]</sup> This enables tulsi to exert anti-inflammatory effects comparable to nonsteroidal anti-inflammatory drugs such as phenylbutazone,<sup>[68]</sup> ibuprofen, naproxen, aspirin<sup>[69]</sup> and indomethacin.<sup>[70]</sup>

### Infection protection

Modern research has revealed that tulsi has anti-bacterial, anti-viral and anti-fungal activity<sup>[71]</sup> that includes activity against many pathogens responsible for human infections. Tulsi has also been shown to boost defenses against infective threats by enhancing immune responses in nonstressed and stressed animals<sup>[72-77]</sup> and healthy humans.<sup>[78]</sup> While no human trials have been published, there is experimental evidence that tulsi may help in the treatment of various human bacterial infections including urinary tract infections,<sup>[79]</sup> skin and wound infections,<sup>[80]</sup> typhoid fever,<sup>[81]</sup> cholera,<sup>[82]</sup> tuberculosis,<sup>[83]</sup> gonorrhea,<sup>[84]</sup> acne,<sup>[85]</sup> herpes

simplex,<sup>[86]</sup> leishmaniasis,<sup>[87]</sup> various pneumonias<sup>[88]</sup> and fungal infections,<sup>[89-92]</sup> as well as mosquito-borne diseases such as dengue, malaria and filariasis.<sup>[93-95]</sup>

Tulsi has also been shown to be active against many animal pathogens, and this has led to tulsi being used in animal rearing to reduce infections in cows,<sup>[96]</sup> poultry,<sup>[97]</sup> goats,<sup>[98]</sup> fish<sup>[76,77]</sup> and silkworms.<sup>[99]</sup> Tulsi's activity against water-borne and food-borne pathogens further suggests that it can be used in the preservation of food stuffs<sup>[100-102]</sup> and herbal raw materials<sup>[103]</sup> as well as for water purification<sup>[82]</sup> and as a hand sanitizer.<sup>[104]</sup>

Tulsi's broad-spectrum activity, which includes activity against *Streptococcus mutans*, the organism responsible for tooth decay, further suggests that it can be used as a herbal mouth wash for treating bad breath, gum disease and mouth ulcers.<sup>[105,106]</sup> This has been confirmed in clinical trials that have demonstrated that rinsing with tulsi is as effective as 0.2% Chlorhexidine and Listerine in reducing the levels of *Streptococcus mutans*.<sup>[107]</sup> and that a herbal mouthwash that includes tulsi is preferred for its taste and convenience.<sup>[108]</sup>

Tulsi's unique combination of antibacterial antioxidant, anti-inflammatory and analgesic activities also makes it useful in wound healing.<sup>[109,110]</sup> This is supported by experimental evidence that has shown that tulsi can increase wound-breaking strength and accelerate wound healing in laboratory animals.<sup>[110,111]</sup> Tulsi has also been shown to have anti-ulcer and ulcer-healing activity that has been observed in many different animal models including aspirin-, indomethacin-, alcohol-, histamine-, reserpine-, serotonin-, acetic acid-, meloxicam-, cold restraint-, pyloric ligation- and stress-induced ulceration models.<sup>[25,112-114]</sup> This anti-ulcer activity is attributed to multiple actions including the reduction of offensive factors such as acid-pepsin secretion and lipid peroxidation and the enhancement of gastric defensive factors such as mucin secretion, cellular mucus and longevity of mucosal cells.<sup>[114,115]</sup>

### Mental stress

In addition to physical, toxic and infective stress, modern living is associated with heightened levels of psychological stress caused by the many demands and fast pace of modern life. This stress compounds the toxic effects of chemical pollutants and the constant fear of pervasive toxic chemicals can itself lead to even further stress and anxiety that may be just as toxic as the chemicals causing it. While the reality of daily chemical exposure cannot be denied, regular consumption of tulsi not only helps protect and detoxify the body's cells and organs, it can also help reduce toxic stress by relaxing and calming the mind and offering many psychological benefits including anti-depressant activity and positive effects on memory and cognitive function.

The psychotherapeutic properties of tulsi have been explored in various animal experiments that reveal that tulsi has anti-anxiety and anti-depressant properties,<sup>[116-118]</sup> with effects comparable to diazepam and antidepressants drugs.<sup>[119,120]</sup> Animal studies further reveal that tulsi enhances memory and cognitive function<sup>[121,122]</sup> and protects against aging-induced memory deficits.<sup>[123]</sup> Similarly, in human studies, tulsi has been observed to reduce stress, anxiety and depression,<sup>[124]</sup> with a 6-week, randomized, double-blind, placebo-controlled study reporting that tulsi significantly improves general stress scores, sexual and sleep problems and symptoms such as forgetfulness and exhaustion.<sup>[125]</sup>

While modern scientific studies suggest that tulsi is effective in treating a range of stressful conditions, within Ayurveda, tulsi is more commonly recommended as a preventive measure to enhance the ability to adapt to both psychological and physical stress and therefore prevent the development of stress-related diseases. To this end, many Ayurvedic practitioners recommend the regular consumption of tulsi tea as an essential lifestyle practice.

### Liquid yoga

Regular consumption of tulsi tea may be compared with the regular practice of yoga, which can be considered "adaptogenic" through nurturing and nourishing the body -- mind -- spirit while fostering a sense of relaxation and wellbeing. In contrast, regular consumption of caffeinated beverages such as black and green tea (*Camellia sinensis* L.) and coffee (*Coffea arabica* L.) may be compared with more aerobic exercise, which confers health benefits through stimulation and activation.

Like yoga, tulsi has a calming effect that leads to clarity of thought, along with a more relaxed and calm disposition. The cognitive and memory-enhancing properties of tulsi therefore differ from those of caffeine-containing beverages such as coffee and tea, which heightens arousal and may cause physical and mental agitation. Furthermore, tulsi does not produce the same physical dependence as caffeine and can be safely consumed on a regular basis without the fear of withdrawal effects.

The drinking of tea and coffee has become an integral part of modern life and has been ritualized in many cultures to guide social interactions, set social agendas and invoke spiritual awareness. For example, sophisticated Asian tea ceremonies involve a whole set of rituals, tools and gestures that serve to transcend normal consciousness, while in the west the ritual of "afternoon tea" or "high tea" emphasizes the surroundings, equipment, manners and social circle. In less-formal situations, many people ritualize their morning cup of coffee and use the "meet-up for coffee" to arrange

their social agendas, while the “tea break” is often built into the modern-day work routine. Yet, while tea and coffee have infiltrated their way into modern living, they have not yet attained the status that tulsi has within traditional Indian life.

### Divine tulsi

In Hinduism, tulsi is worshipped as a goddess and every part of the tulsi plant is revered and considered sacred, including the leaves, stem, flower, root, seeds and oil. Even the surrounding soil, which has recently been found to harbor beneficial endophytic fungi,<sup>[126]</sup> is considered an aspect of the divine. As such, Hindi households are considered incomplete without a tulsi plant, typically in an ornate earthen pot situated in a courtyard where tulsi serves both practical and ceremonial purposes. For example, tulsi’s distinct clove-like aroma arising from its high eugenol content serves to link the householder to the divine while also repelling mosquitoes, flies and other harmful insects. Tulsi is further integrated into daily life through evening and morning rituals and other spiritual and purification practices that can involve ingesting its leaves or consuming tulsi tea.

In addition to sanctifying the home, tulsi is used ceremonially in Hinduism and some Greek Orthodox Churches to create “holy water.” Tulsi wood or seeds are also used to make tulsi malas, which are strings of beads used to help the mind focus during meditation, chanting and devotional practices and therefore ceremonially connect mind, body and spirit. Tulsi has also been used in cities to combat air pollution and hundreds of thousands of tulsi plants have been planted around the Taj Mahal in Agra to help protect the iconic marble building from environmental pollution damage.<sup>[127]</sup>

### Nature nurture

The cultivation and reverence for the tulsi plant in the home not only serves specific religious purposes it also directly connects the devotee with the creative power of nature. Connection with nature is profoundly healing and life-affirming; yet, the potential health, emotional, social and cognitive benefits of connection with nature are only just being realized in the west where disconnection from nature and “nature deficit” are common. A review of the scientific literature on the health benefits of connection to nature suggest that “access to nature plays a vital role in human health, wellbeing and development that has not been fully recognized,”<sup>[128]</sup> and there is now a global movement to reconnect people with nature that has arisen out of concerns over nature deficit, sedentary lifestyles, obesity, mental health issues, excessive use of electronic media, environmental degradation, wildlife conservation, sustainability and climate change.<sup>[129]</sup>

The placing of a living tulsi plant at the center of the household, therefore, has applicability beyond the realms of Hinduism and may play a useful role in addressing modern day issues through embodying the healing power of the natural world and serving as a constant connection to living nature.

### Quality assurance and identification

Like any medicinal plant, optimal cultivation, harvesting, preservation and storage methods are required to preserve tulsi’s medicinal value. For example, it is suggested that tulsi should be grown employing organic methods in rural areas free from environmental pollution.<sup>[3]</sup> This is supported by the finding of toxic elements at almost twice the concentration in tulsi leaves grown in polluted compared with unpolluted areas.<sup>[130]</sup>

It is also important to ensure the correct herb is used and that manufacturers adopt stringent quality assurance standards and processes. Concerns about product quality in European “tulsi” products have been raised by reports of a high frequency of substitution with surrogate herbs such as *Ocimum basilicum* L.<sup>[131]</sup> This may be addressed using high-performance liquid chromatography fingerprints and microscopic assays to ensure batch-to-batch quality and the safety and botanical integrity of standardised extracts of standardized extracts.<sup>[131,132]</sup>

### Tulsi as a vehicle of consciousness

Perhaps one of the greatest of tulsi’s benefits in the modern world comes from its global distribution based on its cultivation using ethical, fair trade, organic and ecological farming practices. There is a growing realization that in order to tackle issues of food security, rural poverty, hunger, environmental degradation and climate change a shift in agriculture is needed from a “green revolution” to an “ecological intensification revolution. This has been highlighted in a recent United Nations document titled “Wake Up Before It’s Too Late,” which calls for the global community to endorse and advocate for local solutions to toxicity, food insecurity and poverty, such as the use of organic and small-scale farming over the use of genetically modified organisms and monocultures.<sup>[133]</sup> While ecological farming methods are not specific to tulsi, they have been effectively applied to tulsi cultivation by Organic India Pvt. Ltd. This company, which was established as a “vehicle of consciousness,” works with thousands of organic tulsi farmers in India to produce a business ecology whereby rural Indian farmers gain their dignity and a healthy and sustainable livelihood while serving to nurture the land they live on and produce a range of teas that enable consumers around the world to access the benefits of tulsi.

## CONCLUSION

Modern day scientific research into tulsi demonstrates the many psychological and physiological benefits from consuming tulsi and provides a testament to the wisdom inherent in Hinduism and Ayurveda, which celebrates tulsi as a plant that can be worshipped, ingested, made into tea and used for medicinal and spiritual purposes within daily life. In providing a focus for ethical, sustainable and ecological farming practices that provides a livelihood for thousands of farmers, the cultivation of tulsi goes beyond providing benefits for individuals and households and begins to address broader social, economic and environmental issues.

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