

# Sweet Basil (*Ocimum basilicum*) Products as Medical Treatment of Human Diseases

Muhammad Arshad Ullah <sup>1\*</sup>, Ali Hassan <sup>2</sup> and Ameer Hamza <sup>3</sup>

<sup>1</sup> Pakistan Agricultural Research Council, Islamabad, Pakistan.

<sup>2</sup> PMAS- University of Arid Agriculture, Rawalpindi, Pakistan.

<sup>3</sup> COMSATS- Biosciences Department, Islamabad Campus, Pakistan.

**\*Corresponding author:** Muhammad Arshad Ullah, Department of Food Science and Nutrition, University of Mysore, Mysuru, 570 006, India.

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## Abstract:

Sweet basil is cultivated for production of essential oils, dry leaves as a culinary herb, condiment/spice or as an ornamental plant. It is used as an ingredient in *Ocimum basilicum* L. commonly called as Sweet Basil belongs to family Lamiaceae is native plant of Indo-Malayan region. It is called the “king of herbs” which contains plenty of phytochemicals with significant nutritional as well as antioxidant capabilities and health benefits. Sweet basil is cultivated for production of essential oils, dry leaves as a culinary herb, condiment/spice or as an ornamental plant. It is used as an ingredient in various dishes and food preparations, especially in the Mediterranean cuisine. The unique array of active constituents called flavonoids found in basil provides protection at cellular level. Orientin and vicenin are two water-soluble flavonoids that have been of particular interest in basil. Essential oil of basil, obtained from its leaves, has demonstrated the ability to inhibit several species of pathogenic bacteria that have become resistant to commonly used antibiotic drugs. Due to its antimicrobial, insecticidal activity and very pleasant aroma, basil essential oil is widely used in the food, pharmaceutical, cosmetic, and aromatherapy industries. In addition, now-a-days public prefers natural food additives hence naturally derived antimicrobial agents from basil have become more important in antimicrobial packaging as they present a perceived lower risk to consumers. Aromatic leaves and flowering parts of *O. basilicum* are traditionally used as stimulant and tonic agents used in folk remedies to treat various ailments such as poor digestion, stomach-ache, feverish illnesses, nausea, abdominal cramps, gastro-enteritis, migraine, insomnia, depression, gonorrhoea, dysentery, and chronic diarrhoea exhaustion. Externally, they have been applied for the treatment of acne, loss of smell, insect stings, snake bites, and skin infections. Rosmarinic acid (RA) is the most biologically active compound present in Basil. The extract of the herb is used in preventing cardiovascular diseases through improved diet and several antioxidant compounds it contains display a high antioxidant power. The extracts have been shown to display important effects at the cellular level, including a platelet antiaggregant property and inhibitory activity against HIV to decrease plasma lipid content. Some of the medicinal properties that basil has are that it can be used to cure coughs, headaches, abdominal aches, and kidney diseases. Basil oils have been classified into four chemotypes according to their chemical composition and geographical source. The European type, cultivated in Europe, USA, and Africa, is characterized by linalool and methyl chavicol as the major oil constituents. The Reunion type, located in the Comoros and Seychelles Islands, Africa, and Reunion Island, is characterized by a high concentration of methyl chavicol. Tropical type originated from India, Pakistan, Guatemala, Haiti, and Africa is rich in methyl cinnamate. Another basil chemotype, with eugenol as the main component, is common in North Africa, Russia, Eastern Europe, and parts of Asia. In addition to these, other basil oils have also been reported which contained various quantities of linalool, camphor, methyl chavicol, methyl cinnamate, and eugenol.

**Key words:** culinary herb; orientin and vicenin; rosmarinic acid and methyl cinnamate

## Introduction

*Ocimum basilicum* L. commonly called as Sweet Basil belongs to family Lamiaceae is native plant of Indo-Malayan region. Sweet basil is cultivated for production of essential oils, dry leaves as a culinary herb, condiment/spice or as an ornamental plant. It is used as an ingredient in *Ocimum basilicum* L. commonly called as Sweet Basil belongs to family Lamiaceae is native plant of Indo-Malayan region. It is called the “king of herbs” which contains plenty of phytochemicals with significant nutritional as well as antioxidant capabilities and health benefits (Yayasinghe *et al.*, 2003).

Sweet basil is cultivated for production of essential oils, dry leaves as a culinary herb, condiment/spice or as an ornamental plant. It is used as an ingredient in various dishes and food preparations, especially in the Mediterranean cuisine (Zheljazkov *et al.*, 2007).

Sweet Basil has shown unique health protecting effects due to its important flavonoids and volatile oils. The unique array of active constituents called flavonoids found in basil provides protection at cellular level. Orientin and vicenin are two water-soluble flavonoids that have been of particular interest in basil (Nyak and Uma, 2005). Essential oil of basil, obtained from its leaves, has demonstrated the ability to inhibit several species of pathogenic bacteria that have become resistant to commonly used antibiotic drugs (Opalachenoiva and Obreshkova, 2005). Due to its antimicrobial, insecticidal activity and very pleasant aroma, basil essential oil is widely used in the food, pharmaceutical, cosmetic, and aromatherapy industries. In addition, now-a-days public prefers natural food additives hence naturally derived antimicrobial agents from basil have become more important in antimicrobial packaging as they present a perceived lower risk to consumers (Sappakul *et al.*, 2003). Aromatic leaves and flowering parts of *O. basilicum* are traditionally used as stimulant and tonic agents used in folk remedies to treat various ailments such as poor digestion, stomach-ache, feverish illnesses, nausea, abdominal cramps, gastro-enteritis, migraine, insomnia, depression, gonorrhoea, dysentery, and chronic diarrhoea exhaustion. Externally, they have been applied for the treatment of acne, loss of smell, insect stings, snake bites, and skin infections (Martin and Ernst, 2004).

The genus *Ocimum* L. includes approximately 150 species, possessing a great variation in plant morphology and biology, essential oil content, and chemical composition (Danesi *et al.*, 2008). *Ocimum basilicum*, popular known as Basil or Sweet Basil, is a common herb that belongs to Lamiaceae family. Studies have shown many pharmacological effects in several diseases, with potent antioxidant, anti-aging, anticancer, antiviral, and antimicrobial properties (Sakr, Al-Amoudi, 2012). Studies have reported that rosmarinic acid (RA) is the most biologically active compound present in Basil related to this activities (Javanmardi *et al.*, 2002; Lee, Scagel, 2009; Shiga *et al.*, 2009).

Traditionally, basil has been used as a medicinal and aromatic herb, to add aroma and flavor to food (Vieira and Simon, 2000) basil contains several secondary metabolites like polyphenols, flavonoids, and terpenes, with recognized potential biologic effects that have been identified in this species (Lee and Scagel, 2009). Researchers have also tried to establish a standard of composition for basil, both in the extract and in oil, but the existence of more than 25 different types of *O. basilicum*, with many constitutional differences (Lee *et al.*, 2005; Liber *et al.*, 2011) makes the task impossible.

Basil (*Ocimum basilicum* L.) is an important species of cultivated aromatic and medicinal plants belonging to the Lamiaceae (mint family). This family Lamiaceae includes about 3,200 species of annuals and non woody perennials which are widely distributed almost all over the temperate and tropical regions of the world (Tucker and DeBaggio, 2000; May *et al.*, 2008; Sullivan, 2009).

Basil is usually referred as the “king of the herbs”, being widely utilized due to its economic, culinary, industrial, and medicinal importance. An extract of the herb is used in preventing cardiovascular diseases through improved diet and several antioxidant compounds it contains display a

high antioxidant power (Erum *et al.*, 2011). The extracts have been shown to display important effects at the cellular level, including a platelet antiag-gregant property and inhibitory activity against HIV to decrease plasma lipid content.

It has also demonstrated strong hypolipidemic action in a murine model of induced hyperlipidemia, decreasing both plasma triglycerides (TG) and cholesterol in acute hyperlipidemia induced by Triton WR-1339 in rats (Bravo *et al.*, 2008).

In Ethiopia, the tender stems, leaves, and flowers are dried, ground, and added to sauces either alone or mixed with other spices to provide a fine flavour to stews. It is an important ingredient in berbere and shiro powders and the preparation of clarified (spiced) butter. Te dried leaves can be used for preparing roast beef locally known as “tibs” and both dried and fresh inflorescences and leaves are used as favoring agents in the preparation of all kinds of “wote”. According to a report (Yimer, 2010), Ethiopia has exported 68,786 kg of basil essential oil to Sudan and the USA, from which a total foreign currency of \$54,991.20 and \$746.00, respectively, was obtained back in 2009. According to Telci *et al.* (2006), the differences of essential oil content between 18 genotypes can range from 0.4% to 1.5%. Zheljazkov *et al.* (2008) also evaluated the oil content, composition, and bioactive characteristics of three *Ocimum* species as affected by growth stages. Teir results revealed 115, 123, and 51 kg ha<sup>-1</sup> total essential oil yields were obtained from *O. basilicum* ‘German’, ‘Mesten’, and local cultivars respectively.

Essential oil content and yield are also affected by intra row spacing (Patel and Kushwaha, 2013). Daneshian *et al.* (2011; Kobur, 2007, also stated that narrow plant spacing can increase essential oil yield and plant height in contrast to Sullivan *et al.* (2009) who reported essential oil content decreases as plant spacing decreases.

Plants are of the important sources of medicine and a large numbers of drugs in use today are derived from plants. *O. basilicum* L. commonly known as Sweet basil (Lamiaceae) is used in both Ayurvedic and Unani system of medicine (Muralidharan and Dhananjayan, 2004). It is also popular as ornamental crop (Javanmardi *et al.*, 2002). Sweet basil is indigenous to lower hills of Punjab in India, Persia and Sindh but also grown in several Mediterranean countries including Turkey (Nadkarni, 2005). *O. basilicum* is being known by different names in different languages around the world. In Hindi and Bengali, it is known as Babui Tulsi (Nadkarni, 2005; Dymock, 2005). In English, it is known as Basil, Common Basil or Sweet Basil. In Arabic the plant is known as Badrooj, Hebak or Rihan; as Nasabo or Sabje in Gujrati and as Jangli Tulsi in Urdu. Tohrakhusaniand Okimon are the names of the plant in Persian and Unani languages respectively (Kirtikar and Basu, 2003).

Basil was originated in Asia and Africa. In Hindu houses, basil is used to protect the family from evil spirits. In early 1600s, the English used basil in their food and in doorways to ward off uninvited pests, such as flies as well as evil spirits. Sweet basil has been grown and sold in New York State since the end of the 18th century (Sperry, 2009).

Sweet basil is an autogamous, aromatic and herbaceous plant that is annual and perennial, grows 1-2 feet in height. Basil produced large green leaves around 2 inches in length, throughout the summer. Basil flowers are commonly removed to increase yield of leaves (Blank *et al.*, 2012).

The genus *Ocimum* L. (Lamiaceae) comprises more than 30 species that are found in tropical and subtropical regions. Due to their economic importance, the most cultivated species in the world are *O. x citriodorum* Vis., *O. americanum* L., *O. basilicum* L., *O. gratissimum* L., *O. minimo* L., and *O. tenuiflorum* L. (Stanko *et al.*, 2010).

Basil (*Ocimum basilicum*.) is a medicinal plant traditionally used for the treatment of respiratory and intestinal problems and kidney malfunction (Lorenzi and Matos, 2008). Basil is economically important due to the use of its essential oil in hygiene and cleaning products, perfumes, and cosmetics and as a local anesthetic and antiseptic (Liber *et al.*, 2011). Furthermore, basil essential oil has been tested in the control of plant pests

(Erler *et al.*, 2006; Chang *et al.*, 2009) and diseases (Zhang *et al.*, 2009) and has been shown to act as an antioxidant (Politeo *et al.*, 2006) and an antimicrobial (Carovi *et al.*, 2010).

Basil has a complicated taxonomy due to the numerous varieties of cultivars within the species that do not differ significantly in morphology. Thus, the classification of genotypes only by morphological features becomes difficult due to anthropogenic interference with selection, cultivation, and hybridization. Due to the hybridization of several species and varieties, there is a wide variability of the chemical constituents (Valls, 2007).

Genotype characterization based on the chemical constitution of the essential oil has been used in several cultures such as *Zingiber officinale* (Wohlmuth *et al.*, 2006) and *Hyptis suaveolens* (Azevedo *et al.*, 2002), including plants of the genus *Ocimum*, with emphasis on *O. basilicum* (Telci *et al.*, 2006).

The chemical characterization of 38 basil genotypes resulted in seven groups: linalool (19–73%); linalool/eugenol (28–66% linalool and 5–29% eugenol); methyl chavicol (20–72% methyl chavicol); methyl chavicol/linalool (8–29% methyl chavicol and 8–53% linalool); methyl eugenol/linalool (two accessions with 37% and 91% methyl eugenol and 60% and 15% linalool); methyl cinnamate/linalool (9.7% methyl cinnamate and 31% linalool); and bergamotene (one accession with bergamotene as the major constituent) (Zheljzakov *et al.*, 2008).

Morphological and agronomic characterization of 55 basil accessions showed genetic variability in *Ocimum* sp. The present study observed genotypic variations in relation to the content and yield of essential oil, and promising genotypes were noted for the development of cultivars with high content and yield of essential oil rich in linalool and other active ingredients (Blank *et al.*, 2004).

Sweet basil (*Ocimum basilicum* L.) is one of the most economically important aromatic herbs of the Lamiaceae family. The plant originates from southern Asia. Currently, it is cultivated mainly through the Mediterranean regions of Europe, as well as in Asia, and Africa. However, it is also grown in temperate zones. The commercial products obtained from basil are fresh and dry herbs used as seasoning, while its extracts and essential oil are exploited in the food and perfume industries (Purushothaman *et al.*, 2008).

Medicinal application of the essential oil is also reported (Siddiqui *et al.*, 2012; Bora *et al.*, 2011; Pandey *et al.*, 2014). The herb contains 0.04%–0.70% essential oil, with linalool, methyl chavicol (syn. estragole), 1, 8-cineole, and eugenol as dominant compounds responsible for its specific aroma (Purushothaman *et al.*, 2008; Tsasi *et al.*, 2017; Liu *et al.*, 2012; D'Antuono *et al.*, 2007). Flavonoids, including quercetin and kaempferol glycosides, as well as phenolic acids with a predominance of caeic acid, are also present in basil herbs (D'Antuono *et al.*, 2007).

Among basil cultivars, seven forms were distinguished concerning leaf shape, size, and color, as well as plant height and habit (Wichtl, 2004). In turn, methyl chavicol is a phenylpropene substance (an isomer of anethole) with anti-lipase and anti-inflammatory effects (Santos, 2018). Some toxic activity is related with this compound. Thus, the chemotypes rich in methyl chavicol are not considered appropriate for therapeutic use (De Souza Silva-Comar *et al.*, 2014; EMA, 2014). The plant is also sensitive to water stress. A regular supply of water is necessary to obtain good-quality raw material (Damalas, 2019).

However, irrigation, especially via sprinklers, may cause some dangerous diseases and contribute to a decrease in the content of the essential oil. Basil, similarly to other aromatic plants grown for fresh herbs, is mainly cultivated in a system of conventional production, including hydroponics. In such production, application of pesticides against common soil pathogens, such as *Pythium*, *Alternaria*, and *Rhizoctonia*, causing root rot, or other fungi connected with high air humidity, such as *Botrytis*, is necessary (Gilardi *et al.*, 2018). This may result in the presence of harmful pesticide residues in the resultant fresh herb (Rheinholds *et al.*, 2017). Thus, it seems obvious that the cultivation of these plants in an organic production system, free of synthetic chemicals, is the most desired

approach and meets consumer expectations connected with the lack of pesticide residues in foods and their safety. As mentioned before, basil is cultivated in many regions of the world. On a larger scale, both for fresh and dry herbs, the plant is grown in the open field, which makes the production cheaper. The advantages of such production include the possibility to cultivate plants over vast areas, easy application of fertilizers or irrigation, and simple, mechanical harvest. On the other hand, in such conditions, it is impossible to control environmental factors, such as light quality, wind, or temperature.

In order to produce high-quality crops in organic systems, in a pesticide-free and environmentally friendly manner, a trend to cultivate some species (especially leafy herbs or vegetables) in soil under mesh-protected enclosures recently appeared (Murillo-Amador *et al.*, 2013; Romero-Games *et al.*, 2009).

Aromatic and medicinal plants have received great attention in the last few years because of their multiple uses, such as basil (*Ocimum basilicum* L.) as it can be used for its essential oil, dry leaves, and flowers and also as an ornamental plant (Makri *et al.*, 2007; Aczek *et al.*, 2019). Basil has more than 60 different species that were reported throughout the world, and some of them can have important uses (Carovic-Stanko *et al.*, 2010; Rewers and Jędrzejczyk, 2016). Some of the medicinal properties that basil has are that it can be used to cure coughs, headaches, abdominal aches, and kidney diseases. Despite the medicinal properties that basil has, there are also a number of other uses, such as it is used in foods and beverages and can be used as insect repellent (Juliani and Simon, 2002). Another important characteristic is that basil can be used to produce essential oil with high economic value because it contains important components, such as eugenol, chavicol, and their derivatives, and terpenoids, like monoterpene alcohol linalool, methyl cinnamate, and limonite. In addition, different chemotypes of *Ocimum basilicum* L. with a specific chemical composition of essential oils were found (Nacar and Tansi, 2000).

Basil is an underutilized crop species with great potential for using it as an alternative crop in many countries because of the many different uses. There are a few studies about the genotypes, the essential oil content, the composition of the essential oil, the effect of fertilization, and growing conditions, such as density, but the effect of water availability was not adequately determined, especially under field conditions. Ekren *et al.* (2012) found that purple basil was very sensitive to water stress, leading to a significant reduction in the dry matter yield. Despite the fact that there are only a few studies that determined the effect of water stress on basil under field conditions, there are also other studies that were conducted in pots and determined the effect of water stress (Yassen *et al.*, 2003; Asadollahi *et al.*, 2013). When *O. basilicum* L. and *O. americanum* L. were exposed to different levels of water stress in pot experiments, they showed significant differences in fresh and dry weight, essential oil content, the main components of the essential oil, proline content, total carbohydrate content, content of major nutrients, such as N, P, K, and protein content decreased (Khalid, 2006). In addition, Yassen *et al.* (2003) reported that the irrigation of basil at 0.6 and 0.8 irrigation water/cumulative pan evaporation ratio showed the highest herb yield. Under water stress, there was an increase in essential oil content (Omidbaigi *et al.*, 2003). However, others found that irrigation levels did not affect essential oil content and essential oil components (Singh, 2003). Basil is characterized by a large leaf area (Bekhradi *et al.*, 2015), and also, the water consumed per area can be up to 849 mm (Ekren *et al.*, 2012; Ghamarnia *et al.*, 2015).

*Ocimum basilicum* L., named commonly as sweet basil, is a popular culinary herb belonging to the Lamiaceae family. *O. basilicum* known as lahbeq in Algeria (Delille, 2007) and called rehan in Arabic (Hanif *et al.*, 2011), is originally native to India and other Asian regions. Today, it is cultivated all over the world. Traditionally, the basil leaves are used in folk medicine as a remedy for a large number of diseases, including cancer, convulsion, diarrhea, epilepsy, gout, nausea, sore throat, toothaches, and bronchitis (Duke *et al.*, 2008; Khalid *et al.*, 2006).

It is also a source of EO containing biologically-active constituents which possess antioxidant and antimicrobial properties (Burt, 2004; Hanif *et al.*, 2011). The chemical composition of basil oil has been the subject of several studies. Basil oils have been classified into four chemotypes according to their chemical composition and geographical source. The European type, cultivated in Europe, USA, and Africa, is characterized by linalool and methyl chavicol as the major oil constituents. The Reunion type, located in the Comoros and Seychelles Islands, Africa, and Reunion Island, is characterized by a high concentration of methyl chavicol. Tropical type originated from India, Pakistan, Guatemala, Haiti, and Africa is rich in methyl cinnamate. Another basil chemotype, with eugenol as the main component, is common in North Africa, Russia, Eastern Europe, and parts of Asia. In addition to these, other basil oils have also been reported which contained various quantities of linalool, camphor, methyl chavicol, methyl cinnamate, and eugenol (Franz *et al.*, 2010). EOs are obtained from plants by various conventional and unconventional processes, such as mechanical pressing, maceration, solvent extraction, supercritical fluid and subcritical water extractions, and HD (Chemat, 2011). An original method, the solvent-free microwave extraction (SFME), has been developed and was patented in 2004 (Chemat *et al.*, 2004). SFME is one of the newest techniques for EOs extraction assisted by microwaves, without any solvent or water, at atmospheric pressure. The advantages of using microwave energy are correlated to its effective heating and faster energy transfer and the fact that it is environmentally friendly (Lucchesie *et al.*, 2004; Asghari *et al.*, 2012; Filly *et al.*, 2014).

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