



REVIEW ARTICLE

# Lavender and Purple Revolution: A review on the crop potential to boost and empower farming communities of North-Western Himalayas

Ambika Sharma<sup>1</sup>, Nidhi Sharma<sup>2\*</sup>, Nayan Deep<sup>3</sup>, Thaneshwari<sup>4</sup>, Ajay Kumar Pandav<sup>2</sup> & Radhajogita Mondal<sup>2</sup>

<sup>1</sup>School of Agriculture, Lovely Professional University, Phagwara 144 411, Punjab, India

<sup>2</sup>Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara 144 411, Punjab, India

<sup>3</sup>Department of Vegetable Science, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni-Solan 173 230, Himachal Pradesh, India

<sup>4</sup>ICAR-Directorate of Floricultural Research, Pune 411 036, Maharashtra, India

\*Correspondence email - [nidhisharmauf@gmail.com](mailto:nidhisharmauf@gmail.com)

Received: 09 June 2025; Accepted: 25 August 2025; Available online: Version 1.0: 26 September 2025

**Cite this article:** Sharma A, Sharma N, Deep N, Thaneshwari, Pandav AK, Mondal R. Lavender and Purple Revolution: A review on the crop potential to boost and empower farming communities of North-Western Himalayas . Plant Science Today. 2025;12(sp1):01–09. <https://doi.org/10.14719/pst.9943>

## Abstract

Lavender (*Lavandula spp.*), a perennial flowering plant known for its distinctive aroma and medicinal properties, has been popularized all over the world. Lavender has its depictions in the ancient literature of Greeks and Romans as an herb with calming, antibacterial and anti-inflammatory properties which can help with stress relief, sleep, skin care and overall wellness. France, Bulgaria and India are the major lavender producers, with the latter experiencing a significant upsurge in commercial cultivation as a part of the Purple Revolution in recent years. With the objective of empowering farmers through improved socioeconomic development, higher income and sustainable farming, the Indian government launched the 'Purple Revolution' under CSIR Aroma Mission in the Union Territories of Jammu and Kashmir and Himachal Pradesh. Lavender cultivation has improved environmental sustainability by fostering biodiversity, reducing soil erosion and adding richness to the agricultural landscape of India. Lavender cultivation has huge commercial potential as it is becoming an important component of a number of medicinal and aromatic industries due to increased consumer demand for natural and organic products. Hence, the expansion of lavender cultivation during the Purple Revolution offers improved agri-entrepreneurship opportunities for international trade and financial prosperity for farming communities.

**Keywords:** Aroma; lavender; medicinal; potential; purple revolution

## Introduction

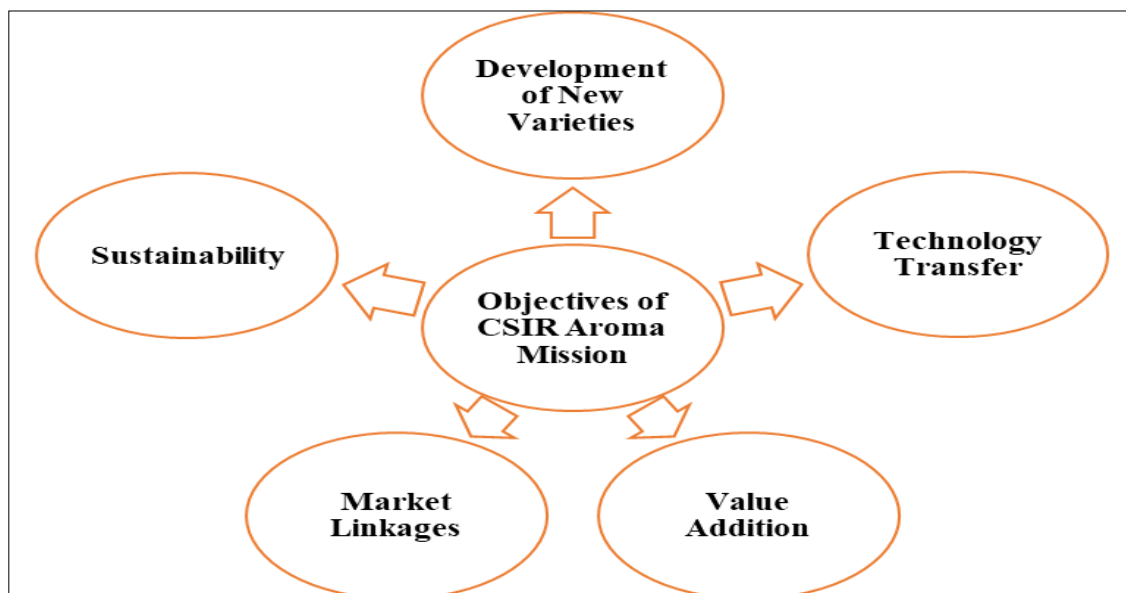
In 2016, the 'Purple Revolution'- a campaign focused on lavender cultivation in India, was launched under the CSIR Aroma Mission initiated by the Council of Scientific and Industrial Research. The Aroma Mission was initiated to exponentially proliferate the cultivation, processing and marketing of aromatic plants in India to ensure higher agricultural income as well as sustainability in the farming communities (Fig. 1). This mission primarily focuses on promoting the production of various aromatic crops like lavender, geranium, rosemary etc., as these crops find their major utilisation in the perfumery, cosmetic and pharmaceutical industries. Among all these crops, lavender is one of the important crops that holds a promising position in the national as well as international aromatic market (1, 2). The present review is aimed at highlighting the botanical, cultural, economic and industrial aspects of lavender cultivation, with special emphasis on India's Purple Revolution and its socio-economic significance.

## Lavender taxonomy and botany

Lavender scientifically known as *Lavandula angustifolia*, is a small flowering shrub, a member of the mint family Lamiaceae

and a native of the Mediterranean hills (3, 4). It is predominantly classified as a temperate shrub adaptive to growing conditions of areas receiving abundant sunlight with lithophilic soil structures. It has been successfully introduced to Australia, the United States and Southern Europe (5). The shrub possesses gray-green, hoary linear leaves along with numerous branches that can grow up to 60 cm (24 inches) tall (6, 7). Their purple flowers are produced in clusters with tall stalks, further developing into small nutlet type fruits. The characteristic aroma of the plant comes from the oil glands located within little star-shaped trichomes (plant hairs) over the flowers, leaves and stems. The name *Lavandula* is derived from the Latin word *Lavare*, which means 'to wash' (8, 9). The meaning signifies its importance from the ancient Greek culture where the lavender oil was used for bathing, cleaning and air freshening properties.

Lavender is a perennial shrub in the *Lavandula* genus that is known for its decorative appeal and essential oils. These plants are small and bushy, with grey-green leaves and long, flowering stems. The leaves can be simple or split, measuring between 30 and 50 mm in length. Lavender blooms on tall spikes 20-40 cm long, with lilac or blue flowers. It generally grows 0.4 m tall and can live for 20-30 years. Lavender, also known as true



**Fig. 1.** Main objectives of CSIR aroma mission.

lavender, medicinal lavender or English lavender, originated in the Mediterranean, Middle East and India (7, 10).

Lavender grows best in a variety of climatic conditions but grows well in between 7 °C and 21 °C (44.6 °F–69.8 °F), demanding full exposure to bright sunlight during the day. Lavender prefers light, sandy soil that drains easily and has a pH of 5.8 to 8.3 (11, 12). Once established, the plants can withstand dry conditions; however they require regular watering when originally transplanted. Lavenders with smaller bloom heads, such as *L. stoechas* and *L. dentata*, have beautiful bracts and grow higher. When grown in full sunlight and fertile soil with enough nutrients, they can grow up to three feet tall. Their flexible stems usually have a greener appearance. Although they grow in the Atlantic islands, Turkey, Pakistan, India and mountainous regions of the western Mediterranean, the majority of lavender species are native to these regions.

#### Historic mentions of Lavender

The use of lavender for both aromatic and medicinal purposes is well-documented in ancient texts. In Traditional Chinese Medicine (TCM), lavender has been used to treat anxiety, panic, topical skin infections, infertility, upset stomach and insomnia (13). Lavender was originally used in Arabic medicine to heal stomach aches and kidney problems (14). It was popular as an aphrodisiac during the Victorian era and traditional medicine claimed it could treat everything from discomfort to hair loss (15, 16). The plant's extracts have also been used to improve bile flow, fix bleeding ulcers, relieve carpal tunnel syndrome and function as an antidepressant, muscle relaxant, gas reliever, nausea treatment, diuretic and general tonic (17–20). Certain varieties of lavender have even been used to treat worms and relieve bug stings (14, 21). Today, lavender is widely used in fragrances, soaps, candles and scented sachets. It is frequently used in little amounts in teas and foods, such as the French herb blend called herbs de Provence (22).

Lavender has been used for various purposes over the centuries, from perfume to fighting germs. It is still widely used in households. Recent research shows that lavender essential oils can replace chemical methods to prevent potatoes from sprouting during storage (23, 24). Studies in India have also shown that lavender species can effectively repel insects (25). In

Austria, research has demonstrated that inhaling lavender essential oil has a calming effect (26). Nowadays, most lavender products are made for their essential oils and pleasant smell.

Lavenders' pleasant smell has made it extremely popular in aromatherapy which is a natural therapeutic approach that makes use of concentrated oils known as essential oils derived from plants such as herbs, flowers, leaves and roots (27). These oils have a strong fragrance and are thought to help with physical and mental issues (28). Lavender oil is frequently recommended for a variety of health conditions, including stress, anxiety, depression, tiredness, nausea from traveling and high blood pressure (6, 26). In Europe, it is commonly used in massages to help people calm down, relieve diarrhea in babies and improve appetite (29, 30). Massages using lavender and peppermint oils are also advised for treating tension headaches. The German Commission has authorized tea made from *L. angustifolia* (lavender) to help with restlessness, insomnia and nervous stomach disorders (8). All the above-mentioned historic mentions of lavender depict its popularization as an important medicinal and aromatic plant, which resonates with the present wide applications of this crop in modern pharmaceutical and perfumery industries.

#### Species Grown in India

The genus *Lavandula* comprises at least 28 recognized species (21). *Lavandula dentata* (French lavender), *Lavandula angustifolia* (syn. *L. officinalis*, *L. vera*; garden, English, pink, white, or true lavender), *Lavandula latifolia* (syn. *L. spica*; spike, narrow-leaved, spikenard or elf leaf lavender), *Lavandula intermedia* or *L. hybrida* reverchon or *L. hybrida burnamii* (lavandin, a hybrid of *Lavandifolia* and *L. latifolia*), *L. stoechas* (Spanish, Italian or fringed lavender) and *Lavandula dhofarensis* (Arabic lavender) are some of the more commonly known species believed to have medicinal properties (8). Five species of lavender such as *L. aristibracteata*, *L. citriodora*, *L. dhofarensis*, *L. galgalloensis* and *L. hasikensis* are indigenous to regions such as the Arabian Peninsula, Micronesia, Bulgaria, Russia and both northern and southern Africa (31, 32). These days, these plants are cultivated all over the world, with famous cultivators located in the US, Australia, France, Bulgaria, Russia, Italy, Spain and England (33, 34). The brief description of popular varieties grown in India is illustrated in the Table 1.

**Table 1.** Comparative characteristics of lavender types and cultivars grown in India

Cultivar	<i>Lavandula angustifolia</i> (True lavender)	<i>Lavandula latifolia</i> (Spike lavender)	<i>Lavandula intermedia</i> (Lavandin variety)	<i>Lavandula officinalis</i> (Sher-e-Kashmir variety)
Altitude range (meters above mean sea level)	1600-1700	250-700	700-1000	800-1000
Oil content	0.5 % - 1.5 %.	1.5 % - 2.2 %	3.6 % - 9.9 %	about 100 % higher essential oil yield than standard cultivars
Aroma	sweet, floral, calming	pungent, camphor-like scent	camphoraceous, woody and herbaceous aroma	sweet aroma with balsamic undertone
Growth habit	Small shrub with narrow greyish-green leaves	Taller shrub with broader green leaves	hybrid sub-shrub with evergreen foliage, broader grey-green leaves	hemispherical shrub with thin lanceolate opposite green leaves
Flower type	Purplish blue flowers, 20 to 40 centimeters and are single-stalked	Long spiky flowering growth on multiple stalks	branched inflorescence stalks with dense, violet-blue to white flowers	branched lavender spikes
Uses	cosmetics, perfumery, aromatherapy, landscaping	Pharmaceutical, aromatherapy, nutraceutical	Cosmetics, perfumery, culinary	Therapeutic, aromatherapy, cosmetics, perfumery, landscaping
Unique characteristics	longest-cultivated lavender	More therapeutic uses as compared to true lavender	cross between true and spike lavender	A superior clone developed by CIMAP

two years (34, 39).

### Significance of Purple Revolution

The purple revolution under CSIR Aroma Mission holds its significance in its potential towards economic empowerment, employment generation, sustainability temperate agriculture, agro-diversification and rural community development. It plays a significant role in uplifting the farmer communities of temperate agricultural systems through providing an alternative income source through high value cash crop for progressive farmers and agri-entrepreneurs, while also strengthening the Start-Up India program and encouraging an entrepreneurial spirit in the region. The purple revolution helped around 500 young people, eventually doubling their income. This temperate region agricultural growth can reduce economic limitations, increase shared prosperity and feed an estimated 9.7 billion people by 2050 (2).

### Production technology

Cultivated lavender does not normally produce seeds; instead, it is propagated through root division, cuttings, layering and micropropagation. Light, well-aerated and well-drained soil, rich in organic matter with neutral to alkaline pH, is good for lavender growth. Although tolerant of marginal soils, lavender is highly sensitive to waterlogging and prefers dry conditions (35). Lavender is a resistant plant that tolerates cold temperatures and drought, making it a suitable crop for cultivation under rainfed agriculture. It requires full sunlight conditions; otherwise, yields may be reduced. For proper establishment of plants before winter season, it is ideal to plant lavender in the autumn under sub-temperate conditions. In temperate climates, spring season is recommended for crop plantation to avoid frost (36, 12). The spacing for lavender transplanting should be 4 feet between rows and 30-40 cm apart inside rows. Watering should be done regularly until the crop is fully grown. Irrigation is essential during the flowering stage (11, 37).

The recommended NPK ratio is 100:40:40. A basal application of 20 kg N, 40 kg P<sub>2</sub>O<sub>5</sub> and 40 kg K<sub>2</sub>O per hectare is recommended, followed by two split doses of the remaining 80 kg N over the subsequent two years (38). Weeding should be done by hand or with machinery to avoid damaging the roots and mulching can be done for moisture retention in the soil and prevention of weed growth in the beds. To improve plant health, flower buds should be pruned on a regular basis during the first

Lavender is considered to be ready for harvesting when the lower half of the blossoms open and all the flowers are fully developed. Harvesting usually takes place in early January or late December, depending on the season. The best time to harvest is between four and ten days of flower bud opening, as quality begins to deteriorate after that point. Harvest timing is critical, as favourable weather i.e. lower relative humidity in air is required to avoid degradation of the oil's quality in the presence of excessive moisture and interference with the distillation process, leading to reduced oil yield (11). Moreover, the harvesting of crop should be avoided during the days with intense scorching heat coupled with strong winds in order to avoid oil loss due to evaporation. Similarly, hypothermic climatic conditions during flower development and harvesting are refrained from they prevent the development of esters, significant constituents of lavender oil. Harvesting can be done manually using sickles or shears, or with specialized mechanical equipment built for the purpose. The flower spikes are harvested by cutting at a length of 15-20 cm beneath the blossoms for efficient and uniform handling. Also, the calyx and stem portion of the spike are known to improve the oil concentration and yield (40). Cut flowers with longer stems are frequently harvested within a week after being harvested for oil production and sold in fresh and dry markets (32, 41-42).

### Global businesses/avenue

The global lavender industry presents substantial commercial potential due to rising demand across diverse sectors, including health, wellness, food and cosmetics. To succeed in this field, it is important to examine market trends, maintain high product quality and long-term viability and build strong distribution channels. Several animal studies demonstrate that lavender has anxiolytic, sedative, analgesic, anticonvulsant and neuroprotective effects (30). Lavender has potential applications in multiple sectors such as aromatherapy, pharmaceuticals, nutraceuticals, cosmetics, landscaping, floristry, culinary arts, agro-tourism and even textiles and fashion (35, 43).

### Aromatherapy

Aromatherapy derives its name from the word "aroma" meaning smell and "therapy" meaning treatment. It is a natural technique to repair your mind, body and spirit. Ancient civilizations such as Egypt, China and India have practiced this

approach for more than 6000 years. Aromatherapy uses essential oils, which are highly concentrated plant extracts. It uses plant essential oils, such as breathing them or applying them to massages, to help reduce signs of illness (44-47). Lavender oil, which is particularly common and well-studied, is thoroughly used to treat a variety of mental and physical diseases (48). As a non-drug treatment, lavender aromatherapy is found to be both cost-effective and low risk (49).

Research suggests that lavender aromatherapy can help elderly patients sleep better. A small study in two older patients with dementia found that nighttime aromatherapy with essential oils of *L. angustifolia* and *Anthemis nobilis* improved one patient's sleep and allowed the other to stop taking sleep medication (50). A clinical series of three senior patients with severe insomnia found that inhaling diffused oil of lavender was an effective alternative to previous medication treatment. Patients reported greater quality sleep and spent the same amount of time asleep compared to those taking medication, along with no side effects (51). Adding a single drop of *L. angustifolia* essential oil to nine elderly patients' pillows for one week improved waking up and awareness in eight of them compared to a week without the oil (52). A randomized clinical investigation found that 72 % of elderly patients treated with *L. angustifolia* experienced improved sleeping circumstances over 245 patient-nights for acute medical symptoms. Patients who received aromatherapy slept better than control patients (11 %). 79 % of those who had lavender therapy at midnight reported having a wonderful day, as compared to only 26 % in the control group. In a follow-up study, nine patients who received nightly aromatherapy with lavender for the duration of two weeks received various benefits (53).

A Japanese study indicated that lavender scent reduced subjective excitement and tension without affecting the circulatory system or heart rate (54). A study of 122 patients with critical illnesses in a hospital intensive care unit found that massage using aromatherapy with *L. angustifolia* oil significantly decreased perceived anxiety compared to rest or massage therapy without aromatherapy. There were also no significant differences in blood pressure, heart rate or respiratory rate between the groups (55). Lavender alters human EEG patterns and has an anxiolytic effect. It has been observed that inhaling lavender (diluted to 10 % dosage) for 3 minutes boosts alpha power of EEG, reduces anxiety and improves mood in 40 healthy persons. Lavender is known to be useful in the treatment of acute, chronic or intractable pain (56-57).

### Pharmaceutical

The use of lavender as a natural medicine is well-known. It is widely used to treat bites, vaginal discharge, anal fissures, scalds, nursing injuries and sunburns. Despite its carminative and versine characteristics, it is most commonly used externally, particularly on the temple region, to treat anxious headaches. Lavender extracts can also help to treat bacterial infections such as typhoid, diphtheria, *Streptococcus* and *Pneumococcus* and they are a potent antidote to several snake venoms (58-61).

In recent years, various animal and human studies have used current scientific approaches to examine traditional lavender medicinal treatments. These research raised the possibility of restoring lavender's therapeutic value in neurological diseases on

the assumption of evidence-based medicine (61-62). Lavender has been demonstrated to have anticonflict properties in mice (63). Continuous exposure to lavender aromatic oils for 7 days significantly reduced anxiety and depression-like behaviours in rats, as measured by raised plus-maze and forced swimming tests (64-65). Exposure to lavender significantly corrected spatial memory deficits caused by cholinergic system malfunction (27). In a rat model of Alzheimer's disease (produced by intracerebroventricular injection of A $\beta$ 1), administering lavender successfully restored spatial learning deficits (65). In mice, lavender oil dramatically reduced neurological deficiency scores, infarct size and levels of mitochondrial-generated reactive oxygen species, as well as neuronal damage in a localized cerebral ischemia caused by intraluminal blockage (66). Lavender oil lowered c-fos expression in the hypothalamic paraventricular and dorsomedial nuclei (67). In mice, lavender oil reduced anti-DNP IgE-induced tumor necrosis factor-alpha secretion and histamine release from peritoneal mast cells in a dose-dependent manner (66, 67).

Inhaled lavender is thought to activate the limbic system, specifically its hippocampus and amygdala (68). Linalool and linalyl acetate are quickly absorbed via the skin following topical application with massage and they are thought to promote central nervous system depression (69-70).

### Nutraceutical

For generations, lavender has been utilized in cooking because to its unique flowery aroma. Historically, lavender was largely used in herbal drinks and potpourri. Recently, lavender has become a prominent element in modern cuisine. and the manufacture of numerous food and beverage products. Several lavender types, including English lavender (*Lavandula angustifolia*) and Provence lavender (*Lavandula  $\times$  intermedia*), are grown for culinary reasons. Lavender can be used fresh or dried, depending on personal preference and recipe. Dried lavender is preferred for its concentrated flavour, whereas fresh lavender has a more delicate taste (71-73). Infusion is one of the most common applications for lavender. To extract the flavour and perfume of lavender, steep the buds or sprigs in liquids like water, milk, cream, oil or alcohol. The infusion period varies according on the desired degree of the lavender flavour (74).

Lavender's unique flavour and perfume have captured the attention of chefs and customers in the food business. Lavender is a versatile flavouring agent that complements a variety of foods. Its delicate floral tones and mild sweetness can enhance dishes like cakes, cookies and ice cream, adding an intriguing twist. Lavender may lend complexity to savory meals, particularly in Mediterranean and Provencal cuisine. It pairs well with roasted meats, stews and sauces. Lavender infused oils, honeys and spreads are gaining popularity due to their captivating scents and distinct appeal (75). The use of lavender in food reflects changing preferences for flavour and a desire for distinctive culinary experiences. Lavender's use in menu and food products appeals to consumers seeking unique flavours and a refined eating experience. Lavender is known for its relaxing and calming qualities. The use of this ingredient in culinary products has gained popularity among those seeking a holistic approach to wellness. Lavender-infused teas, beverages and sweets are marketed for their relaxing effects, appealing to health-conscious consumers (43, 76, 77).



Lavender's delicate floral flavour and enticing perfume have been incorporated into many dishes, beverages and food products, bringing elegance and fascination to the culinary world (78). Lavender's popularity in the food business reflects changing customer demands, particularly for holistic wellbeing and distinctive culinary experiences. Lavender's increased appeal stems from its relationship with relaxing and the farm-to-table movement (74, 79).

### Cosmetics and perfumes

Lavender oil's calming impact and dermatologically friendly characteristics make it useful in a variety of industries, including the cosmetic business. Lavender body creams can help reduce tissue scarring by maintaining skin moisture levels. *Lavandula angustifolia* oil has long been prized for its rich aroma and therapeutic properties. Historic mentions of Queen Elizabeth using lavender as a scent reveal that for centuries lavender has been used for its aromatic properties and continues to be a popular choice in perfumery even in present times. Lavender oil was popular among Victorian women as a perfume and it was also employed as an antiseptic during World War I (80, 81).

In ancient times, lavender was considered a holy herb. Furthermore, it was frequently used to freshen and add some fragrance to a number of individual products, like clothes and hair (43, 82). Lavender oil, also known as lilac flower oil, is produced by distilling lavender blossoms and is mostly used in premium perfumes and cosmetic products. Linalool acetate, linalool, pinene, limonene, geraniol and cineole are the aromatic components of this colourless or yellow liquid. Lavender water is a solution of the essential oil in alcohol with other additional smells that is used in a number of toilette treatments (67, 13). Today, lavender is much more than a fragrant shrub. It has been widely utilized for cosmetics and therapeutic purposes.

Lavender has maintained its commercial relevance since antiquity. Its applications in the soap and perfume industries are limitless, including dried arrangements, filler components, incense packets, potpourri, flames, wands, floral bundles, wreaths, wall hangings and so on. Its diverse applications, such as washing agents, mosquito repellents, vital toiletries (soap, shampoo and conditioner, bath oil, moisturizer, bath salt), incense sticks and so on, are quite fascinating. In fact, its fresh leaves could be utilized successfully to control pests. As an organic insecticide, a 2 % blend of rosemary oil and lavender essential oil could be utilized (28, 36, 82-84).

### Landscaping with lavender (ornamental aspects)

Lavender is usually utilized as an ornamental plant rather than for production. Lavender is a beautiful addition to practically any garden. Its foliage is a wide range of colours, from varied greens to grey-green and silver, with variegated types available. Lavender flowers come in a variety of colours, including blues, purples, whites and pinks, in addition to the traditional lavender (48). Lavender needs little water once it has established itself. Drought-tolerant plants may withstand dry spells with little or no additional watering (37, 83). Lavender plants have a wide range of applications in landscape design, including hedges, topiaries, spiral gardens, mazes, raised beds, potted plants and hanging baskets. It gives elegance and a pleasant smell to its surroundings. Certain lavender cultivars flourish indoors, but they can also be grown outside during

the summer for added versatility (79, 83).

Lavender is most commonly used in hedges, which frequently feature minor modifications like as raised or rounded parts at regular intervals. They can be moulded into animals or any other desired shape to provide a more complex touch (10, 79). Lavender is a great plant for maze design because it adds a pleasing visual framework and a pleasant scent that makes the experience of walking through it more enjoyable (83, 85). It has a significant impact on the dried flower industry. Desiccated pale purple flower buds are commonly used in potpourris. Instead of utilizing commercial chemical pest and pest control agents, sachet-sealed dried flowers of lavender could be used as an effective substitute, particularly to scent linens and prevent moths (79). Lavender was found to be essential when making bridal confetti, scented liquids and sachets (4, 10, 36, 85).

Keeping in view the diversified applications of lavender crop, number of studies has been undertaken by researchers from different countries to conclude therapeutical benefits of lavender oil. A comprehensive overview of such studies has been summarised in the Table 2 (86-95).

### Future aspects and conclusion

Lavender is emerging as one of the most valuable oil-bearing crops among popular medicinal and aromatic plants. The diverse benefits of the lavender oil have expanded its market demands, driven by awareness and consciousness regarding healthy lifestyle among consumers over the past few years. Lavender being a low-input crop, owing to its growing adaptability in marginal, less productive rainfed temperate cultivable land, provides diverse opportunities for socio-economic development of farming communities and allied processing industries. Although, unresolved concerns pertaining to adulteration of essential oil, authenticity certification schemes, etc. should be acknowledged to maintain sustainable application and demand for lavender products.

In conclusion, lavender (*Lavandula spp.*) stands out as a remarkable crop known for its medicinal, fragrant and ornamental properties. Its distinctive chemical profile and adaptability make it important in a variety of industries, including aromatherapy, medicines, nutraceuticals, cosmetics and landscaping. The "Purple Revolution", launched by the CSIR Aroma Mission, has transformed lavender production in India, empowering rural communities, developing sustainable methods and boosting the country's position in the global essential oil market. With its numerous applications and contributions to ecological sustainability, rural upliftment and industrial growth, lavender has the potential to be a revolutionary crop for modern agriculture and holistic well-being.

### Acknowledgements

The author(s) are grateful to reviewers from the horticulture department under School of Agriculture, Lovely Professional University, Punjab, India for their constructive feedback and valuable suggestions, which helped enhance the quality of the manuscript. The authors gratefully acknowledge the contributions of the broader scientific community whose

**Table 2.** Case studies on utilisation of lavender in various avenues worldwide

S.No.	Year	Study title and reference	Country of study	Important conclusion
i.	2006	Evaluation of aromatherapy (Lavender) in treating postoperative pain: pilot study (86)	USA	The study concluded significant improvement in patients' satisfaction with their pain control in case of postoperative lavender oil aromatherapy after breast biopsy.
ii.	2012	The effect of lavender aromatherapy on autonomic nervous system in midlife women with insomnia (87)	Thailand	Lavender inhalation twice weekly for 12 weeks significantly improved sleep quality and temporarily enhanced parasympathetic activity (HRV) in midlife women with insomnia.
iii.	2014	Effect of lavender aromatherapy on vital signs and perceived quality of sleep in the intermediate care unit: A pilot study (88)	USA	Lavender aromatherapy in the intermediate care unit modestly lowered overnight blood pressure (midnight–4 AM) which led to a conclusion that lavender aromatherapy can be considered as a non-medicated way to improve sleep in an intermediate care unit.
iv.	2015	Effect of inhalation aromatherapy with lavender essential oil on stress and vital signs in patients undergoing coronary artery bypass surgery: A single-blinded randomized clinical trial (89)	Iran	The said investigation revealed the significant effect on systolic blood pressure as a result of inhalation of 2 % lavender essential oil on postoperative days 2 and 3 after CABG.
v.	2017	Effects of aromatherapy on sleep quality and anxiety of patients (90)	Turkey	Lavender essential oil inhalation over 15 nights significantly improved sleep quality and reduced anxiety levels in coronary ICU patients compared to controls.
vi.	2017	The effects of lavender essential oil aromatherapy on anxiety and depression in haemodialysis patients (91)	Iran	The haemodialysis patients found a notable decrease in depression severity by the end of the fourth week.
vii.	2020	The effect of lavender aroma on anxiety of patients having bone marrow biopsy (92)	Iran	The lowered anxiety scores were observed in the patients inhaling lavender essential oil for 15 min before having bone marrow biopsy, suggesting aromatherapy to be an effective pre-treatment to reduce procedural anxiety.
viii.	2021	Effectiveness of lavender inhalation aromatherapy on pain level and vital signs in children with burns: a randomized controlled trial (93)	Turkey	The children with burns under study were asked to inhale lavender oil before the dressing of wounds and they observed significantly lowered post-dressing pain and stabilized vital signs (respiratory rate, heart rate and mean arterial pressure) compared to placebo group.
ix.	2025	The efficacy of lavender oil on fatigue and sleep quality in patients with haematological malignancy receiving chemotherapy: a single-blind randomized controlled trial (94)	Turkey	Lavender oil inhalation for 5 nights before bedtime significantly improved sleep quality and reduced overall fatigue—including behavioural, sensory and cognitive aspects in chemotherapy-treated patients with haematological malignancies
x.	2025	The effectiveness of lavender aromatherapy on perineal suture pain among postpartum women (95)	Indonesia	This quasi-experimental study of 15 postpartum women demonstrated that 15-minute inhalation of lavender aromatherapy significantly reduced perineal suture pain, indicating it may be an effective non-pharmacological strategy to ease discomfort after childbirth.

published work formed the foundation of this review.

## Authors' contributions

T, RM and AKP contributed to the conceptualization of the research work. T and NS were involved in methodology, while AS and NS carried out the investigation. AS, NS and ND prepared the original draft and ND, AKP and NS contributed to review and editing. T and RM handled visualization and the work was supervised by AKP and ND. All authors have read and approved the final version of the manuscript.

## Compliance with ethical standards

**Conflict of interest:** Authors do not have any conflict of interest to declare.

**Ethical issues:** None

## References

- Anonymous. Bhaderwah has emerged as the Lavender capital of India and Agri StartUp destination, says Union Minister Dr Jitendra Singh. Press Information Bureau. 2023. <https://pib.gov.in/PressReleaseFramePage.aspx?PRID=1929731>
- Kakraliya SS, Jeet S, Verma I, Choskit D, Kumawat PK. A source of doubling farmers income of lavender cultivation in Jammu and Kashmir. Just Agric. 2022;2(5):1-7. <https://justagriculture.in/archives-newsletter/january-2022-newsletter/>
- Toma F. Floriculture and floral art. vol II, Invel Multimedia, Bucharest. 2009. p. 129.
- Szekely-Varga Z, Hitter T, Cantor M. The healing power and the uses in landscape design of lavender (*Lavandula angustifolia* L.). Hop and Medicinal Plants. 2017;25(1-2):47-55. <https://doi.org/10.15835/hpm.v25i1-2.12878>
- Lis-Balchin M, editor. Lavender: The genus *Lavandula*. London: CRC Press; 2002. <https://doi.org/10.1201/9780203216521>
- Bernáth J. Gyógy- és aromanövények. Budapest: Mezőgazda Kiadó. 2000. p. 384-9.
- Draghia L, Chelariu L. Floriculture. Iasi: Ion Ionescu de la Brad. 2012.
- Chu CJ, Kemper KJ. Lavender (*Lavandula* spp.). Longwood herbal task force. 2001.p. 32. <http://www.longwoodherbal.org/lavender/lavender.pdf>
- Simpson MG. Plant systematics. 1st ed. Burlington (MA): Elsevier Academic Press. Review in: Syst Bot. 2006;31(3):631-2. <https://doi.org/10.1043/0363-6445-31.3.631>
- Hank B. Gardens for the senses: Gardening as therapy. Rio Rancho (NM): Petals & Pages Press. 2013. p. 148.
- Muntean LS, Tămas M, Muntean S, Muntean L, Duda MM, Vârban DI, et al. Treatise of cultivated and spontaneous medicinal plants. Cluj-Napoca: Risoprint. 2016;24(1-2):79-81. <https://doi.org/10.15835/hpm.v24i12.12605>
- Crişan I, Ona A, Vârban D, Muntean L, Vârban R, Stoie A, Mihăiescu T, Morea A. Current trends for lavender (*Lavandula angustifolia* Mill.) crops and products with emphasis on essential oil quality. Plants. 2023;12(2):357. <https://doi.org/10.3390/plants12020357>
- Basch E, Foppa I, Liebowitz R, Nelson J, Smith M, Sollars D, Ulbricht C. Lavender (*Lavandula angustifolia* miller). J Herb Pharmacotherapy. 2004;4(2):63-78. [https://doi.org/10.1300/J157v04n02\\_07](https://doi.org/10.1300/J157v04n02_07)
- Ghazanfar SA. Handbook of Arabian medicinal plants. Boca Raton: CRC Press. 1994. <https://doi.org/10.1201/b14834>

15. Duke JA. Crc handbook of medicinal herbs. Int Clin Psychopharmacol. 1990;5(1):74. <https://doi.org/10.1097/00004850-199001000-00014>
16. Hay IC, Jamieson M, Ormerod AD. Randomized trial of aromatherapy: successful treatment for alopecia areata. Arch Dermatol. 1998;134(11):1349-52. <https://doi.org/10.1001/archderm.134.11.1349>
17. Weiss RF. Herbal Medicine. Gothenburg (Sweden): AB Arcanum. 1988. p. 362.
18. Combest WL. Alternative therapies: lavender. U S Pharm. 1999;24:24-33.
19. Hoffmann D. The complete illustrated holistic herbal: A safe and practical guide to making and using herbal remedies. New York (NY): Barnes & Noble. 1996.
20. Fleming T, editor. PDR for herbal medicines. 1st ed. Montvale (NJ): Medical Economics Company. 1998. <https://archive.org/details/pdrforherbalmmedi00joer>
21. Barrett PR. Growing & Using Lavender. Storey's Country Wisdom Bulletin A-155. Storey Publishing. 1996. p. 32.
22. Szejtli J, Kulcsar G, KERNOCZY L.  $\beta$ -Cyclodextrin complexes in talc powder compositions. Cosmetics and toiletries. 1986;101(10):74-9.
23. Giray FH. An analysis of world lavender oil markets and lessons for Turkey. J Essent Oil-Bear Plants. 2018;21(6):1612-23. <https://doi.org/10.1080/0972060X.2019.1574612>
24. Vokou D, Varelzidou S, Katinakis P. Effects of aromatic plants on potato storage: sprout suppression and antimicrobial activity. Agric Ecosyst Environ. 1993;47(3):223-35. [https://doi.org/10.1016/0167-8809\(93\)90124-8](https://doi.org/10.1016/0167-8809(93)90124-8)
25. Sharma RN, Gupta AS, Patwardhan SA, Hebbalkar DS, Tare V, Bhonde SB. Bioactivity of Lamiaceae plants against insects. Indian J Exp Biol. 1992;30:244-6.
26. Buchbauer G, Jirovetz L, Jäger W. Aromatherapy: Evidence for sedative effects of the essential oil of lavender after inhalation. Z Naturforsch C. 1991;46(11-12):1067-72. <https://doi.org/10.1515/znc-1991-11-1223>
27. Kashani MS, Tavirani MR, Talaei SA, Salami M. Aqueous extract of lavender (*Lavandula angustifolia*) improves the spatial performance of a rat model of Alzheimer's disease. Neurosci Bull. 2011;27(2):99. <https://doi.org/10.1007/s12264-011-1149-7>
28. Segen JC. Dictionary of alternative medicine. Stamford (CT): Appleton & Lange; 1998. p. 407.
29. Viuda-Martos M, Mohamady MA, Fernández-López J, Abd ElRazik KA, Omer EA, Pérez-Alvarez JA, et al. *In vitro* antioxidant and antibacterial activities of essential oils obtained from Egyptian aromatic plants. Food control. 2011;22(11):1715-22. <https://doi.org/10.1016/j.foodcont.2011.04.003>
30. Umezu T. Behavioral effects of plant-derived essential oils in the Geller type conflict test in mice. Jpn J Pharmacol. 2000;83(2):150-3. [https://doi.org/10.1016/S0021-5198\(19\)30610-9](https://doi.org/10.1016/S0021-5198(19)30610-9)
31. Chaytor DA. A taxonomic study of the genus *Lavandula*. J Linn Soc Bot. 1937;51:153-204. <https://doi.org/10.1111/j.1095-8339.1937.tb01906.x>
32. Ali B, Al-Wabel NA, Shams S, Ahamad A, Khan SA, Anwar F. Essential oils used in aromatherapy: A systemic review. Asian Pac J Trop Biomed. 2015;5(8):601-11. <https://doi.org/10.1016/j.apjtb.2015.05.007>
33. Hassiotis CN, Tarantilis PA, Daferera D, Polissiou MG, Etherio. A new variety of *Lavandula angustifolia* with improved essential oil production and composition from natural selected genotypes growing in Greece. Ind Crop Prod. 2010;32(2):77-82. <https://doi.org/10.1016/j.indcrop.2010.03.004>
34. Gallotte P, Fremondière G, Gallois P, Bernier JP, Buchwalder A, Walton A, et al. *Lavandula angustifolia* Mill. and *Lavandula × intermedia* Emeric ex Loisel: lavender and lavandin. In: Medicinal, aromatic and stimulant plants. Cham: Springer International Publishing. 2020. p. 303-11. [https://doi.org/10.1007/978-3-030-38792-1\\_6](https://doi.org/10.1007/978-3-030-38792-1_6)
35. Mason J. Growing and Knowing Lavender. Nerang (QLD, Australia): ACS Distance Education. 2014. p. 117.
36. Platt ES. Lavender: How to grow and use the fragrant herb. Mechanicsburg (PA): Stackpole Books; USA. 2009.
37. Batra P. Lavender cultivation guide: season, seed rate, field preparation, transplanting and irrigation. Krishi Jagran. 2022.
38. Coltun M. Step-by-Step Creation of a Lavender Plantation. J Bot. 2016;8:76-80.
39. Vârban R, Vârban DI, Stoie A, Bogdan I, Odagiu A, Ghete A. Identification of weed species present in lavender crops (*Lavandula angustifolia* L.) and (*Mentha piperita* L.) from the UASVM Cluj-Napoca Campus. Hop Med Plants. 2018;26:101-114. <https://doi.org/10.15835/hpm.v26i1-2.13238>
40. Wilson TM, Poulson A, Packer C, Carlson RE, Buch RM. Essential oil profile and yield of corolla, calyx, leaf and whole flowering top of cultivated *Lavandula angustifolia* Mill. (Lamiaceae) from Utah. Molecules. 2021;26(8):2343. <https://doi.org/10.3390/molecules26082343>
41. Giannoulis KD, Evangelopoulos V, Gougoulis N, Wogiatzi E. Lavender organic cultivation yield and essential oil can be improved by using bio-stimulants. Acta Agric Scand B Soil Plant Sci. 2020;70:648-656. <https://doi.org/10.1080/09064710.2020.1833974>
42. Détár E, Zámboi-Németh É, Gosztola B, Harmath A, Ladányi M, Pluhár Z. Ontogenesis and harvest time are crucial for high quality lavender-role of the flower development in essential oil properties. Ind Crops Prod. 2021;163:113334. <https://doi.org/10.1016/j.indcrop.2021.113334>
43. Wells R, Truong F, Adal AM, Sarker LS, Mahmoud SS. *Lavandula* essential oils: a current review of applications in medicinal, food and cosmetic industries of lavender. Nat Prod Commun. 2018;13(10):1-10. <https://doi.org/10.1177/1934578X1801301038>
44. Worwood VA. Aromatherapy for the healthy child: more than 300 natural, nontoxic and fragrant essential oil blends. Novato (CA): New World Library. 2012.
45. Krishna A, Tiwari R, Kumar S. Aromatherapy-an alternative health care through essential oils. J Med Aromat Plant Sci. 2000;798-804. 10.5555/20013071731
46. Song X, Peng J, Jiang W, Ye M, Jiang L. Effects of aromatherapy on sleep disorders: A protocol for systematic review and meta-analysis. Medicine. 2021;100(17):e25727. <https://doi.org/10.1097/MD.00000000000025727>
47. Aliasgharpour M, Abbaszadeh R, Mohammadi N, Kazemnejad A. Effect of lavender aromatherapy on the pain of arteriovenous fistula puncture in patients on hemodialysis. Nurs Pract Today. 2016;3(1):26-30. <https://npt.tums.ac.ir/index.php/npt/article/view/125>
48. Farrar AJ, Farrar FC. Clinical aromatherapy. Nurs Clin North Am. 2020;55(4):489. <https://doi.org/10.1016/j.cnur.2020.06.015>
49. Wolfe N and Herzberg J. Can aromatherapy oils promote sleep in severely demented patients?. Int J Geriatr Psychiatry. 1996;11(10):926-7. [https://doi.org/10.1002/\(SICI\)1099-1166\(199610\)11:10<926::AIDGPS473>3.0.CO;2-1](https://doi.org/10.1002/(SICI)1099-1166(199610)11:10<926::AIDGPS473>3.0.CO;2-1)
50. Hardy M, Kirk-Smith M, Stretch D. Replacement of drug treatment for insomnia by ambient odour. The Lancet. 1995;346(8976):701. [https://doi.org/10.1016/S0140-6736\(95\)92310-1](https://doi.org/10.1016/S0140-6736(95)92310-1)
51. Hudson R. Use of lavender in a long-term elderly ward. Nurs Times. 1995;91(1):12.
52. Hudson R. The value of lavender for rest and activity in the elderly patient. Complement Ther Med. 1996;4(1):52-7. [https://doi.org/10.1016/S0965-2299\(96\)80057-4](https://doi.org/10.1016/S0965-2299(96)80057-4)
53. Motomura N, Sakurai A, Yotsuya Y. A psychophysiological study of lavender odorant. Memoirs of Osaka Kyoiku University Series III Natural Science & Applied Science. 1999;47:281-287. [https://doi.org/10.1007/978-3-030-38792-1\\_6](https://doi.org/10.1007/978-3-030-38792-1_6)



- [naturalingredient.org/wp/wp-content/uploads/KJ472300281.pdf](https://naturalingredient.org/wp/wp-content/uploads/KJ472300281.pdf)
54. Dunn C, Sleep J, Collett D. Sensing an improvement: An experimental study to evaluate the use of aromatherapy, massage and periods of rest in an intensive care unit. *J Adv Nurs*. 1995;21(1):34-40. <https://doi.org/10.1046/j.1365-2648.1995.21010034.x>
  55. Diego MA, Jones NA, Field T, Hernandez-Reif M, Schanberg S, Kuhn C, et al. Aromatherapy positively affects mood, EEG patterns of alertness and math computations. *Int J Neurosci*. 1998;96(3-4):217-24. <https://doi.org/10.3109/00207459808986469>
  56. Ching M. Contemporary therapy: Aromatherapy in the management of acute pain?. *Contemp Nurse*. 1999;8(4):146-51. <https://doi.org/10.5172/conu.1999.8.4.146>
  57. Gorji A. Pharmacological treatment of headache using traditional Persian medicine. *Trends Pharmacol Sci*. 2003;24(7):331-4. [https://doi.org/10.1016/S0165-6147\(03\)00164-0](https://doi.org/10.1016/S0165-6147(03)00164-0)
  58. Adaszyńska-Skwrzyńska M, Szczepińska D. The effect of lavender (*Lavandula angustifolia*) essential oil as a drinking water supplement on the production performance, blood biochemical parameters and ileal microflora in broiler chickens. *Poult Sci*. 2019;98: 358–365. <https://doi.org/10.3382/ps/pey350>
  59. Hui L, He L, Huan L, XiaoLan L, AiGuo Z. Chemical composition of lavender essential oil and its antioxidant activity and inhibition against rhinitis-related bacteria. *Afr J Microbiol Res*. 2010;4(4):309-13. <https://academicjournals.org/journal/AJMR/article-full-text-pdf/7E1D8A42867>
  60. Moon T, Cavanagh, M.A, Wilkinson JM. Antiparasitic activity of two *Lavandula* essential oils against *Giardia duodenalis*, *Trichomonas vaginalis* and *Hexamita inflata*. *Parasitol Res*. 2006;99(6):722-728. <https://doi.org/10.3390/molecules26082343>
  61. Denner SS. *Lavandula angustifolia* miller: english lavender. *Holist Nurs Pract*. 2009;23(1):57-64. <https://doi.org/10.1097/01.HNP.0000343210.56710.fc>
  62. Gilani AH, Aziz N, Khan MA, Shaheen F, Jabeen Q, Siddiqui BS, et al. Ethnopharmacological evaluation of the anticonvulsant, sedative and antispasmodic activities of *Lavandula stoechas* L. *J Ethnopharmacol*. 2000;71(1-2):161-7. [https://doi.org/10.1016/S0378-8741\(99\)00198-1](https://doi.org/10.1016/S0378-8741(99)00198-1)
  63. Hritcu L, Cioanca O, Hancianu M. Effects of lavender oil inhalation on improving scopolamine-induced spatial memory impairment in laboratory rats. *Phytomedicine*. 2012;19(6):529-34. <https://doi.org/10.1016/j.phymed.2012.02.002>
  64. Hartman D, Coetzee JC. Two US practitioners' experience of using essential oils for wound care. *J Wound Care*. 2002;11(8):317-20. <https://doi.org/10.12968/jowc.2002.11.8.26432>
  65. Wang D, Yuan X, Liu T, Liu L, Hu Y, Wang Z, et al. Neuroprotective activity of lavender oil on transient focal cerebral ischemia in mice. *Molecules*. 2012;17(8):9803-17. <https://doi.org/10.3390/molecules17089803>
  66. Shaw D, Annett JM, Doherty B, Leslie JC. Anxiolytic effects of lavender oil inhalation on open-field behaviour in rats. *Phytomedicine*. 2007;14(9):613-20. <https://doi.org/10.1016/j.phymed.2007.03.007>
  67. Cavanagh HM, Wilkinson JM. Biological activities of lavender essential oil. *Phytother Res*. 2002;16(4):301-8. <https://doi.org/10.1002/ptr.1103>
  68. Kim NS, Lee DD. Comparison of different extraction method for the analysis of fragrance from *Lavandula* species by gas chromatography-mass spectrometry. *J Chromatogr A*. 2002;982:31-47. [https://doi.org/10.1016/S0021-9673\(02\)01445-0](https://doi.org/10.1016/S0021-9673(02)01445-0)
  69. Jager W. Percutaneous absorption of lavender oil from massage oil. *J Soc Cosmet Chem*. 1992;4:49. <https://www.naturalingredient.org/wp/wp-content/uploads/p00049-p00054.pdf>
  70. Stanojević L, Stanković M, Cakić M, Nikolić V, Nikolić L, Ilić D, et al. The effect of hydrodistillation techniques on yield, kinetics, composition and antimicrobial activity of essential oils from flowers of *Lavandula officinalis* L. *Hem Industry*. 2011;65(4):455-463. <https://doi.org/10.2298/HEMIND110129047S>
  71. Dudareva N, Pichersky E, Gershenzon J. Biochemistry of plant volatiles. *Plant Physiol*. 2004;135(4):1893-902. <https://doi.org/10.1104/pp.104.049981>
  72. Skendi A, Irakli M, Chatzopoulou P, Bouloumpasi E, Biliaderis CG. Phenolic extracts from solid wastes of the aromatic plant essential oil industry: Potential uses in food applications. *Food Chem Adv*. 2022;1:100065. <https://doi.org/10.1016/j.focha.2022.100065>
  73. Prusinowska R, Smigielski K, Stobiecka A, Kunicka-Styczyńska A. Hydrolates from lavender (*Lavandula angustifolia*)—their chemical composition as well as aromatic, antimicrobial and antioxidant properties. *Nat Prod Res*. 2016;30:386–393. <https://doi.org/10.1080/14786419.2015.1016939>
  74. Jigău R, Imbrea F, Pașcalău R, Smuleac L. Lavender and its modern use in food industry nowadays. *Res J Agric Sci*. 2023;55(2). [https://rjas.ro/download/paper\\_version.paper\\_file.851b883c8e639819.SklHQVUucGRm.pdf](https://rjas.ro/download/paper_version.paper_file.851b883c8e639819.SklHQVUucGRm.pdf)
  75. Jianu C, Pop G, Gruia AT, Horhat FG. Chemical composition and antimicrobial activity of essential oils of lavender (*Lavandula angustifolia*) and lavandin (*Lavandula × intermedia*) grown in Western Romania. *Int J Agric Biol*. 2013;15(4):772-6. <https://www.cabidigitallibrary.org/doi/abs/10.5555/20133240844>
  76. Gharib FA, Badr SE, Al-Ghazali BA, Zahran MK. Chemical composition, antioxidant and antibacterial activities of lavender and marjoram essential oils. *Egypt J Chem*. 2013;56:1-24. <https://doi.org/10.21608/ejchem.2013.1071>
  77. Hussain AI, Anwar F, Iqbal T, Bhatti IA. Antioxidant attributes of four Lamiaceae essential oils. *Pak J Bot*. 2011;43(2):1315-21.
  78. Iriti M, Colnaghi G, Chemat F, Smadja J, Faoro F, Visinoni FA. Histo-cytochemistry and scanning electron microscopy of lavender glandular trichomes following conventional and microwave-assisted hydro distillation of essential oils: a comparative study. *Flavour Fragr J*. 2006;21(4):704-12. <https://doi.org/10.1002/ffj.1692>
  79. Zsolt SV, Cantor M. Lavender an Admired Shrub by Landscapers. *Pro Environment*. 2019;12:328-32. <https://journals.usamvcluj.ro/index.php/promediu/article/view/13596>
  80. Prusinowska R, Smigielski KB. Composition, biological properties and therapeutic effects of lavender (*Lavandula angustifolia* L.). A review. *Herba Pol*. 2014;60:56–66. <https://doi.org/10.2478/hepo-2014-0010>
  81. Malakar M. *Lavandula* spp. (Lavender): a herb more than just a relaxing scent. In *advances in medicinal and aromatic plants; vol.1*. Apple Academic Press. 2024. p. 315. <https://doi.org/10.1201/9781032686905-8>
  82. Radu (Lupoae) D, Alexe P, Stănciuc N. Overview on the potential role of phytochemicals from lavender as functional ingredients. *Ann Univ Dunarea Jos Galati Fascicle VI-Food Technol*. 2020;44:173–188. <https://doi.org/10.35219/foodtechnology.2020.2.11>
  83. Cooper Marcus C, Sachs NA. Therapeutic landscapes: An evidence-based approach to designing healing gardens and restorative outdoor spaces. Hoboken (NJ): Wiley. 2014.
  84. Prashar A, Locke IC, Evans CS. Cytotoxicity of lavender oil and its major components to human skin cells. *Cell Prolif*. 2004;37(3):221-9. <https://doi.org/10.1111/j.1365-2184.2004.00307.x>
  85. Simonet-Avril A. Lavender: Lavender in nature and garden, home and kitchen; KubiK/RvR: Kehl. Germany. 2005.
  86. Kim JT, Wajda M, Cuff G, Serota D, Schlame M, Axelrod DM, et al. Evaluation of aromatherapy in treating postoperative pain: pilot study. *Pain Practice*. 2006;6(4):273-7. <https://doi.org/10.1111/j.1533-2500.2006.00095.x>
  87. Chien LW, Cheng SL, Liu CF. The effect of lavender aromatherapy on autonomic nervous system in midlife women with insomnia. *Evidence-based complementary and alternative medicine*. 2012;2012(1):740813. <https://doi.org/10.1155/2012/740813>
  88. Lytle J, Mwatha C, Davis KK. Effect of lavender aromatherapy on vital



- signs and perceived quality of sleep in the intermediate care unit: A pilot study. *Am J Crit Care*. 2014;23(1):24-9. <https://doi.org/10.4037/ajcc2014958>
89. Bikmoradi A, Seifi Z, Poorolajal J, Araghchian M, Safiaryan R, Oshvandi K. Effect of inhalation aromatherapy with lavender essential oil on stress and vital signs in patients undergoing coronary artery bypass surgery: A single-blinded randomized clinical trial. *Complementary therapies in medicine*. 2015;23(3):331-8. <https://doi.org/10.1016/j.ctim.2014.12.001>
  90. Karadag E, Samancioglu S, Ozden D, Bakir E. Effects of aromatherapy on sleep quality and anxiety of patients. *Nurs Crit Care*. 2017;22(2):105-12. <https://doi.org/10.1111/nicc.12198>
  91. Bagheri-Nesami M, Shorofi SA, Nikkhah A, Espahbodi F. The effects of lavender essential oil aromatherapy on anxiety and depression in haemodialysis patients. *Pharm Biomed Res*. 2017;3(1):8-13. <https://doi.org/10.18869/acadpub.pbr.3.1.8>
  92. Abbaszadeh R, Tabari F, Asadpour A. The effect of lavender aroma on anxiety of patients having bone marrow biopsy. *Asian Pac J Cancer Prev*. 2020;21(3):771. <https://doi.org/10.31557/APJCP.2020.21.3.771>
  93. Akgül EA, Karakul A, Altın A, Doğan P, Hoşgör M, Oral A. Effectiveness of lavender inhalation aromatherapy on pain level and vital signs in children with burns: A randomized controlled trial. *Complement Ther Med*. 2021;60:102758. <https://doi.org/10.1016/j.ctim.2021.102758>
  94. Yildirim D, Harman Ozdogan M, Erdal S, Selcuk S, Guneri A, Simsek EB, et al. The efficacy of lavender oil on fatigue and sleep quality in patients with hematological malignancy receiving chemotherapy: A single-blind randomized controlled trial. *Support Care Cancer*. 2025;33(2):1-0. <https://doi.org/10.1007/s00520-024-09143-5>
  95. Prihartini AR, Rachmawati L, Sari OH. The Effectiveness of Lavender Aromatherapy on Perineal Suture Pain among Postpartum Women. *Int J Nat Health Sci*. 2025;3(1):351-60. <https://doi.org/10.59890/ijnhs.v3i1.119>

#### Additional information

**Peer review:** Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

**Reprints & permissions information** is available at [https://horizonpublishing.com/journals/index.php/PST/open\\_access\\_policy](https://horizonpublishing.com/journals/index.php/PST/open_access_policy)

**Publisher's Note:** Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Indexing:** Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc  
See [https://horizonpublishing.com/journals/index.php/PST/indexing\\_abstracting](https://horizonpublishing.com/journals/index.php/PST/indexing_abstracting)

**Copyright:** © The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited (<https://creativecommons.org/licenses/by/4.0/>)

**Publisher information:** Plant Science Today is published by HORIZON e-Publishing Group with support from Empirion Publishers Private Limited, Thiruvananthapuram, India.