



Lavender (*Lavandula*) Plant's Pharmacognostic and Biological Structure, Species, and Geographical Distribution

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ABSTRACT

This article is dedicated to the pharmacognostic and biological structure of the lavender plant, its species, and its medicinal applications. The paper discusses the historical origins, distribution, morphological features, and main species of lavender, including *Lavandula angustifolia* (English lavender) and *Lavandula intermedia* (lavandin). The flowers and other parts of the plant are rich in essential oils, which are widely used in pharmacology, cosmetics, and the perfume industry. Lavender, especially its essential oils, with their calming, antibacterial, and anti-inflammatory properties, play an important role in the production of natural medicinal products. The article also provides information on recent research and industrial development in Uzbekistan regarding the cultivation of lavender and the production of natural therapeutic products.

Keywords:

Lavender, medicinal plant, essential oils, pharmacognosy, distribution, medicinal use

Introduction

Lavender (*Lavandula*) is a herbaceous plant from the Lamiaceae family, primarily distributed in the Mediterranean region. It is widely recognized for its essential oils and high pharmacological properties. Lavender is primarily known as a medicinal and aromatic plant, with its flowers, leaves, and other parts being widely used in various industries, including pharmaceuticals, cosmetics, and perfumery. This article is dedicated to studying the pharmacognostic and biological structure of the lavender plant, its most important species, and their medicinal applications. Lavender flowers and essential oils are famous for their calming, antibacterial, and anti-inflammatory properties, and they are used in the treatment of various diseases and to strengthen the body. The article also provides detailed information

on the climatic conditions, morphological characteristics, and its role in industry. Lavender oil has antiseptic and bactericidal properties. Lavender flowers (*Lavandula flores*) contain active ingredients (3%), anthocyanins, sugars, phytosterols, minerals, and tannins and are mainly used for plant-based purposes. The descriptive and analytical composition of lavender essential oil varies depending on the genotype, growing region, climatic conditions, reproduction, and morphological characteristics [10]. Lavender has been used for many years in traditional medicine and aromatherapy, as well as in the perfume, cosmetics, and food industries. In ancient times, aromatic substances were primarily used for embalming purposes [17]. In Traditional Chinese Medicine (TCM), lavender is used to treat a range of diseases, including infertility,

infections, anxiety, and fever [18]. During the Victorian era, lavender was commonly used as an aphrodisiac [19]. During World War I, the demand for lavender was very high, as it was used to disinfect wounds when mixed with sphagnum moss [20]. It is also commonly planted in garden courtyards and dried for use as a fragrant agent for shelves and cabinets [36].

Macroscopic and Microscopic Structure of Lavender

Lavender (*Lavandula*) is a herbaceous plant belonging to the Lamiaceae family,

distinguished by its richness in essential oils [1]. Lavender belongs to the shrub or semi-shrub group, with approximately 47 species, 25 of which are found along coastal areas [2]. It typically grows to a height of 50-70 cm. Lavender bushes are composed of clusters of shoots, and their diameter is around 1 meter. Lavender is drought-resistant and does not require irrigation throughout the year. Most importantly, once planted, the seedlings can produce crops for up to 30-50 years [3].



1. External appearance of the lavender flower



Fig. 2. Appearance of the dried lavender flower



Fig. 3. Lavender plantation

**The native land of lavender is the Mediterranean, particularly along the coasts of Spain and France, where it grows wild on rocky slopes [4]. The distribution of the species is determined by the distribution of sedimentary rocks and shales.

Its natural range includes southern France, the Pyrenees of France and Spain, and the Alpine mountains of Italy [5]. Although it grows in Turkey's Mediterranean region, it is distributed

almost worldwide [6]. The genus *Lavandula* consists of approximately 39 species, mainly originating from the Mediterranean, with over 100 varieties [7]. In species with short stems, the flower crown is tubular, consisting of five parts at the top. The upper lip has two parts, flat and upright [8]. The flower's corolla is fused, tube-shaped, with five lobes, blue-yellow in color, and up to 5 mm in length. Along the length of the corolla, 10–13 parallel veins are clearly

visible. The corolla lobes are uneven and hairy. The flower is bilabiate, with the upper lip having two lobes and the lower lip three lobes, pink-brown in color, up to 10 mm in length [39]. The flower clusters have diuretic, antispasmodic, and calming effects, improving cerebral circulation. Lavender oil has antiseptic and bactericidal properties. A solution of essential oil encourages wound healing without rough scarring [9]. Lavender flowers (*Lavandula flores*) contain active compounds (3%), anthocyanins, sugars, phytosterols, minerals, and tannins, and are mainly used for

plant-based purposes. The descriptive and analytical composition of lavender essential oil varies depending on genotype, growing region, climatic conditions, reproduction, and morphological characteristics [10]. Lavender plants root at a depth of about 80-100 cm, depending on soil and climatic conditions. The plant has many lateral branches. Its leaves are oppositely arranged, with a length of 2-6 cm. Due to strong pubescence, the leaves have an unusual color — gray and blue-green. The leaves themselves are linear, with sharp tips and curled edges [38].**

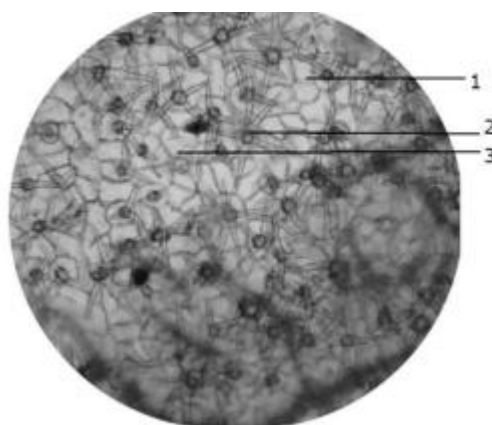


Fig. 4. Microscopic preparation of the broad-leaved leaf of Lavender (*Lavandula angustifolia*):
 1 – Epidermal cells of the leaf;
 2 – Star-shaped hairs;
 3 – Essential oil glands.

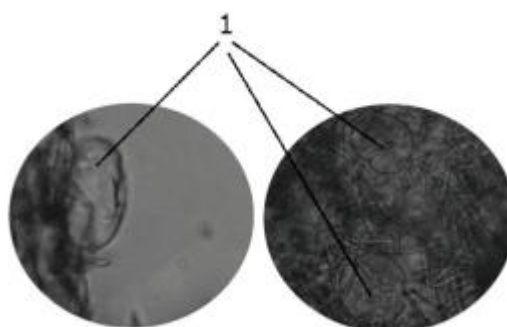


Fig. 5. Essential oil glands.

The flower head is in the form of a spike with a length of 16-20 cm, having 4-6 flower clusters arranged along the spike. Each cluster contains 6-14 flowers, depending on certain factors [11]. In the summer months, the flowers, which have

a strong fragrant aroma, bloom in a blue-violet color. Its fruit is compound, consisting of four elliptical-shaped yellow-brown nutlets. Lavender is a light-loving and heat-loving plant.

It differs from many other plants due to its drought resistance and tolerance to temperatures as low as -30°C [3]. The most valuable part of the plant is its flowers, as they contain significantly more essential oil compared to the leaves, and have an optimal ratio of linalool, linalyl acetate, and camphor [12]. Lavender leaves are commonly used as a flavoring agent in food and beverages, and they are a rich source of phenolic compounds and antioxidants [13].

Lavender Species. Lavender has four main species:

- *L. angustifolia* – commonly known as "English lavender," it is cold-resistant and distinguished by various beautiful varieties, growth habits, and flowering colors (previously known as *L. vera* or *L. officinalis*).
- *L. stoechas* – a large plant with green-gray leaves, it blooms late and has a very strong scent (sometimes referred to as "French lavender").
- *L. latifolia* – native to the Mediterranean region, it is a grass-like type of lavender.
- *L. intermedia* – a sterile hybrid of *L. latifolia* and *L. angustifolia*. The most commonly cultivated genotypes for essential oil production are *L. angustifolia* and *L. × intermedia* (lavandin). However, lavender oil obtained from *L. angustifolia* (English lavender) is sold at 3–5 times the price of lavandin oil because it is considered higher quality [21]. *L. angustifolia*, or lavender, is spread across the mountainous regions of the Mediterranean, from Spain to France and Italy, typically growing at altitudes above 1500 meters. There are two subspecies of *L. angustifolia*: *ssp. angustifolia*, which grows in the French and Italian Alps, and *ssp. pyrenaica*, which originates from the Pyrenees [22]. It grows as a shrub, reaching a width of up to 50 cm, and blooms from mid-June to July [18]. The leaves are simple and entire [22]. Literature describes various pharmacological effects of lavender extracts and *Lavandula angustifolia*

essential oil, such as anticonvulsant (against seizures) [23], antimicrobial (against microbes) [24], anxiolytic [25], antifungal [26], antioxidant [27, 28], and anticholinesterase [27] properties. Additionally, various components of the oil also have valuable pharmacological properties, such as anti-inflammatory, antioxidant, and antimicrobial effects [29, 30, 31]. Natural products and their essential oils are widely used to treat various inflammatory diseases and to develop new treatment strategies. Research shows that the use of natural products may be safer and more effective due to their low toxicity and fewer side effects [32].

Lavandula × intermedia Emeric ex Loisel belongs to the *Lavandula* section and is known as a natural hybrid of *Lavandula angustifolia* Mill. and *Lavandula latifolia* Medik plants [33, 34]. *L. × intermedia* occurs in areas where both parent species are present simultaneously (France and Spain). Depending on the habitat of the parent plants, lavandin grows in sunny places, well-drained, stony, calcareous soils [35].

Geographic Distribution of Lavender.

The native land of lavender is the Mediterranean, particularly along the coasts of Spain and France, where it grows wild on rocky slopes [4]. The distribution of the species is determined by the distribution of sedimentary rocks and shales. Its natural range includes southern France, the Pyrenees of France and Spain, and the Alpine mountains of Italy [5]. Although it grows in Turkey's Mediterranean region, it is distributed almost worldwide [6]. The *Lavandula* plants originated from southern Europe, particularly the western Mediterranean basin, and extend eastward to the Dalmatian coasts and Greece [14]. Lavender can be cultivated in fields and gardens in countries like France, Italy, Spain, Greece, and North Africa, but it also grows naturally at altitudes of 700 to 1800 meters (*Lavandula angustifolia* Mill.). In this region, *Lavandula latifolia* Vill. grows at lower altitudes (400–700 m), while lavender (*Lavandula hybrida* Reverchon) is found at

altitudes of 600–800 m [15]. It is believed that the Romans were the first to spread this species northward to England, where lavender has now

become a very important plant in every garden [16].

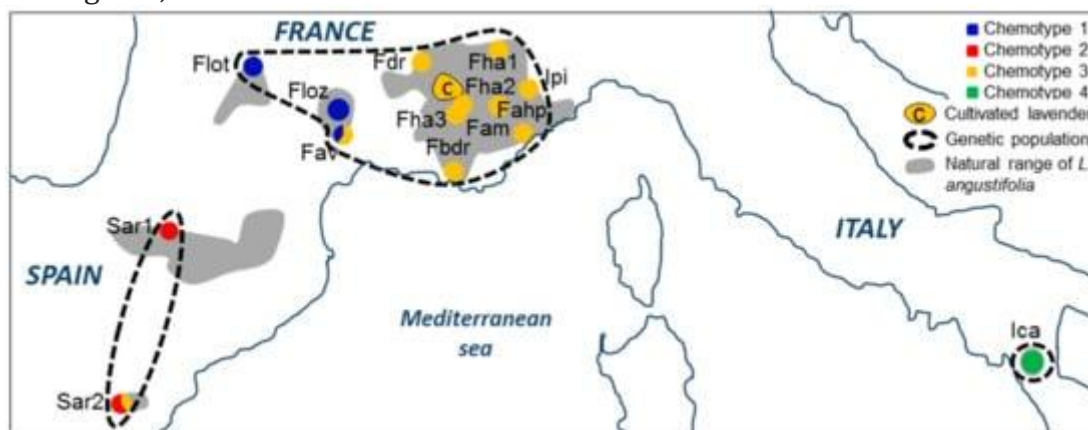


Figure 1. This image shows the chemical and genetic structure of 14 natural sample sites (N = 65) and 5 cultivated fields (N = 25). The gray shaded areas represent the natural distribution range of *Lavandula angustifolia*. Each pie chart illustrates the original location of a sample site, with the chart colors indicating the chemical group affiliation of each site. The black dotted lines represent the three genetic units identified through Discriminant Analysis of Principal Components (DAPC) using genotypes obtained by AFLP (Amplified Fragment Length Polymorphism) analysis. The cultivated fields are grouped in the area marked with the letter "c". [37]

Conclusion: This article presents important information regarding the pharmacognostic and biological properties of lavender (*Lavandula*), its species, and its applications in medicine and industry. The research findings show that lavender flowers and other parts are rich in essential oils, which have calming, antibacterial, and anti-inflammatory effects. The widespread use of lavender in the pharmaceutical, cosmetic, and perfume industries, as well as its significance in traditional medicine, was also explored.

Recent research and development trends in Uzbekistan related to lavender cultivation and essential oil production on an industrial scale were also discussed. The plant's morphological characteristics, adaptability to climate and soil conditions, as well as its high economic efficiency, make lavender a promising product as a medicinal plant. The results of the research provide a scientific basis for further enhancing the future importance of lavender in pharmaceutical and industrial sectors.

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