

REVIEWING OF PLANT BELONGING TO LAMIACEAE FAMILY

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Abstract- The lamiaceae family, commonly known as the mint family, encompasses a diverse group of plants with significant ecological, economic, and cultural importance. In this review, we provide a comprehensive overview of the various aspects related to plants belonging to the lamiaceae family. We explore the botanical classification, morphological characteristics, ecological significance, phytochemistry, economic and cultural importance, as well as conservation status and threats facing lamiaceae plants. Additionally, we discuss the evolutionary history, diversity, and distribution of lamiaceae species, highlighting their role in ecosystems worldwide. Through a synthesis of existing literature and research findings, this review aims to enhance our understanding of the lamiaceae family and its importance in various fields, including medicine, agriculture, horticulture, and conservation. Furthermore, we identify gaps in knowledge and research priorities to guide future studies aimed at further elucidating the complexities of this fascinating plant family.

Keywords: Lamiaceae, botanical classification, morphological characteristics, ecological significance, phytochemistry, economic importance, cultural importance, conservation, threats.

1. INTRODUCTION

The Lamiaceae family, commonly known as the mint family, is a diverse and widespread group of flowering plants comprising over 7,000 species across 236 genera. This botanical family is characterized by aromatic herbs, shrubs, and a few trees, many of which are known for their culinary, medicinal, and ornamental properties. Lamiaceae plants are distributed globally, with a significant presence in temperate and subtropical regions, although some species are found in tropical areas as well. One of the defining features of Lamiaceae plants is the square stems, opposite leaves, and often aromatic foliage [1]. The family includes well-known genera such as *Mentha* (mint), *Rosmarinus* (rosemary), *Thymus* (thyme), and *Lavandula* (lavender), among others. Lamiaceae plants exhibit a wide range of ecological adaptations and are found in diverse habitats, from dry deserts to moist forests. Overall, the Lamiaceae family plays a significant role in ecosystems and human societies, making it an important subject of botanical study and conservation efforts. [2]

1.1. Importance of Lamiaceae Plants

Lamiaceae plants hold significant importance due to their diverse array of uses across various domains, including culinary, medicinal, ecological, and economic spheres. Here are some key aspects highlighting the importance of Lamiaceae plants: [3]

1. **Culinary Uses:** Many Lamiaceae species are valued for their aromatic leaves and culinary flavors. Herbs such as basil (*Ocimum basilicum*), mint (*Mentha* spp.), rosemary (*Rosmarinus officinalis*), and thyme (*Thymus* spp.) are commonly used as flavoring agents in cooking, adding depth and aroma to a wide range of dishes.
2. **Medicinal Properties:** Numerous Lamiaceae plants possess medicinal properties and have been used for centuries in traditional herbal medicine systems worldwide. These plants contain bioactive compounds such as essential oils, flavonoids, and phenolic acids, which exhibit various pharmacological effects, including anti-inflammatory, antimicrobial, antioxidant, and digestive properties.
3. **Aromatic and Essential Oils:** Lamiaceae plants are a rich source of essential oils, which are extracted from their leaves, flowers, and stems. These oils have extensive applications in aromatherapy, perfumery, cosmetics, and pharmaceutical industries. They are valued for their pleasing fragrances and therapeutic properties, contributing to the production of scents, lotions, creams, and natural remedies.
4. **Ecological Role:** Lamiaceae plants play crucial ecological roles in their native habitats. They provide food and habitat for pollinators, including bees, butterflies, and hummingbirds, thereby supporting biodiversity and ecosystem functioning. Additionally, some species exhibit allelopathic properties, influencing plant community composition and competition dynamics.
5. **Ornamental and Horticultural Value:** Several Lamiaceae species are cultivated for their aesthetic appeal and ornamental features. Plants like lavender (*Lavandula* spp.), salvia (*Salvia* spp.), and coleus (*Plectranthus* spp.)

are popular choices in gardens, landscaping, and urban green spaces, enhancing visual appeal and attracting wildlife.

6. **Economic Significance:** The cultivation, processing, and trade of Lamiaceae plants contribute to local and global economies. These plants are commercially grown for their culinary herbs, essential oils, and ornamental value, generating income for farmers, producers, and industries involved in herbal products, cosmetics, and perfumery.

1.2. Taxonomy and Classification of Lamiaceae Plants

1.2.1. Botanical Classification of Lamiaceae

The botanical classification of Lamiaceae, also known as the mint family, follows the hierarchical taxonomic system established by botanists to organize and classify plant species based on their evolutionary relationships and morphological characteristics. Here is an overview of the botanical classification of Lamiaceae: [4]

Kingdom: Plantae

- Lamiaceae belongs to the Plantae kingdom, comprising all multicellular, photosynthetic organisms, including plants, algae, and some fungi.

Division: Magnoliophyta (Angiosperms)

- Lamiaceae is classified within the Magnoliophyta division, also known as angiosperms or flowering plants. Angiosperms are characterized by the presence of flowers and seeds enclosed within fruits.

Class: Magnoliopsida (Dicotyledons)

- Lamiaceae plants belong to the Magnoliopsida class, commonly referred to as dicotyledons or dicots. Dicotyledonous plants typically have two cotyledons (seed leaves), net-veined leaves, and floral parts in multiples of four or five.

Order: Lamiales

- The Lamiales order includes a diverse group of flowering plants, and Lamiaceae is one of the largest families within this order. Other families in the Lamiales order include Verbenaceae, Plantaginaceae, and Oleaceae.

Family: Lamiaceae

- Lamiaceae is the botanical family to which all mint plants belong. It is characterized by aromatic herbs, shrubs, and a few trees with square stems, opposite leaves, and often aromatic foliage. The family includes well-known genera such as *Mentha* (mint), *Salvia* (sage), *Rosmarinus* (rosemary), and *Lavandula* (lavender).

Genus and Species

- Within the Lamiaceae family, there are numerous genera and species, each with unique morphological and ecological characteristics. Examples of genera within Lamiaceae include *Mentha*, *Salvia*, *Rosmarinus*, *Thymus*, and *Ocimum*, among others. Each genus contains multiple species with distinct traits and adaptations.

1.2.2. Diversity within the Lamiaceae Family

The Lamiaceae family, commonly known as the mint family, exhibits remarkable diversity in terms of its botanical characteristics, geographical distribution, and ecological adaptations. Here are some aspects highlighting the diversity within the Lamiaceae family: [5]

1. **Genera and Species:** Lamiaceae comprises over 230 genera and approximately 7,000 species worldwide, making it one of the largest families of flowering plants. This extensive diversity includes a wide range of herbs, shrubs, and a few trees, each with unique morphological traits and ecological adaptations.
2. **Morphological Variation:** Lamiaceae plants display considerable morphological variation, including differences in leaf shape, arrangement, and texture, as well as flower structure, color, and size. Some species have aromatic foliage, square stems, and distinctive inflorescences, while others exhibit variations in growth habit, leaf size, and overall appearance.
3. **Aromatic Herbs:** Many Lamiaceae species are valued for their aromatic properties and essential oils, which contribute to their culinary, medicinal, and ornamental uses. Plants such as basil (*Ocimum basilicum*), mint (*Mentha* spp.), thyme (*Thymus* spp.), and oregano (*Origanum* spp.) are well-known examples of aromatic herbs within the family.
4. **Geographic Distribution:** Lamiaceae plants are distributed worldwide, with a significant presence in temperate and subtropical regions. They are found in diverse habitats, including forests, grasslands, wetlands, and Mediterranean ecosystems. Some species have adapted to extreme environments, such as arid deserts or high-altitude mountain ranges.
5. **Ecological Adaptations:** Lamiaceae species exhibit a range of ecological adaptations to their respective habitats. Some plants are adapted to xeric conditions and have drought-tolerant traits, while others thrive in moist, well-drained soils. Additionally, certain species have evolved specialized mechanisms for pollination, seed dispersal, and defense against herbivores.
6. **Economic and Cultural Importance:** The diversity of Lamiaceae plants contributes to their economic and cultural significance. Many species are cultivated for culinary purposes, herbal medicine, essential oil production, and

ornamental gardening. They play essential roles in traditional medicine systems, cultural rituals, and culinary traditions worldwide.

1.2.3. Evolutionary History of Lamiaceae Species

The evolutionary history of Lamiaceae species is characterized by a complex and dynamic interplay of genetic diversification, ecological adaptations, and geographical dispersal events over millions of years. Molecular phylogenetic studies have revealed that the Lamiaceae family originated during the late Cretaceous period, approximately 60-70 million years ago, and underwent rapid diversification during the Tertiary period. The family is believed to have originated in the Old World, with centers of diversity in Eurasia, Africa, and the Mediterranean region. Over time, Lamiaceae plants adapted to a wide range of habitats, including temperate forests, Mediterranean scrublands, tropical rainforests, and arid deserts, leading to the evolution of diverse morphological and physiological traits [6]. Taxonomic revisions and phylogenetic analyses have elucidated the evolutionary relationships among different genera and species within Lamiaceae, providing insights into their evolutionary history, biogeography, and adaptive radiation. Understanding the evolutionary history of Lamiaceae species is crucial for elucidating their ecological roles, conservation status, and potential responses to environmental changes in the past, present, and future.

1.3. Morphological Characteristics of Lamiaceae Plants

Morphological characteristics play a pivotal role in identifying and classifying Lamiaceae plants, commonly known as the mint family. Within this taxonomic group, several distinct features help differentiate Lamiaceae species from other plant families. One prominent trait is the presence of square stems, a defining characteristic that sets them apart. These stems, often observed in young shoots, result from the unique arrangement of vascular bundles and serve as a reliable diagnostic marker. Additionally, Lamiaceae plants typically exhibit opposite leaves, where leaves are arranged in pairs along the stem in an opposite fashion. The foliage of many Lamiaceae species is also notably aromatic, owing to the presence of essential oils, which confer distinct scents and flavors to herbs like mint, basil, and sage. Moreover, Lamiaceae flowers are characterized by their bilabiate corolla structure, consisting of two distinct lips, and their fruits typically form small, dry nutlets enclosed within the persistent calyx. These morphological characteristics collectively contribute to the diversity and ecological significance of Lamiaceae plants within the botanical realm. [7]

1.4. Phytochemistry of Lamiaceae Plants

The phytochemistry of Lamiaceae plants, also known as the mint family, is rich and diverse, encompassing a wide array of bioactive compounds with various medicinal, aromatic, and culinary properties. One of the most notable phytochemical groups found in Lamiaceae plants is essential oils, which contain volatile compounds responsible for the characteristic aromas and flavors associated with herbs such as mint, basil, and oregano. These essential oils often possess antimicrobial, antioxidant, and anti-inflammatory properties, making them valuable in traditional medicine and aromatherapy. Additionally, Lamiaceae plants are rich sources of phenolic compounds, including flavonoids and phenolic acids, which contribute to their antioxidant activity and potential health benefits. Other bioactive constituents commonly found in Lamiaceae plants include terpenoids, alkaloids, and tannins, each with its own unique pharmacological effects and therapeutic applications. The diverse phytochemistry of Lamiaceae plants underscores their importance in pharmaceutical, cosmetic, and culinary industries, as well as their potential role in drug discovery and natural product research.

1.5. Economic and Cultural Importance of Lamiaceae Plants

Lamiaceae plants hold significant economic and cultural importance globally, contributing to various industries and cultural traditions. From a culinary perspective, herbs such as basil, mint, rosemary, and thyme, all members of the Lamiaceae family, are prized for their aromatic flavors and culinary versatility, enhancing the taste of countless dishes in cuisines around the world. Additionally, Lamiaceae plants are widely utilized in traditional medicine systems, where they are valued for their medicinal properties and therapeutic benefits. Essential oils extracted from Lamiaceae species are utilized in aromatherapy, cosmetics, and perfumery industries due to their pleasant fragrances and potential health-promoting effects. Moreover, these plants play essential roles in cultural practices and rituals, symbolizing prosperity, purity, and protection in various societies. Overall, the economic and cultural importance of Lamiaceae plants underscores their widespread utilization and significance in both traditional and modern contexts.

1.6. Conservation and Threats to Lamiaceae Plants

Conservation efforts for Lamiaceae plants are crucial due to their ecological significance, economic value, and cultural importance. However, these plants face various threats that endanger their survival and diversity. Habitat destruction and fragmentation, primarily driven by urbanization, agriculture expansion, and deforestation, pose significant threats to Lamiaceae species by reducing their available habitat and disrupting ecosystems [8]. Additionally, overexploitation for medicinal, culinary, and commercial purposes, coupled with illegal harvesting and unsustainable harvesting practices, further exacerbate the pressure on wild populations. Climate change also poses a significant threat to Lamiaceae plants, altering temperature and precipitation patterns, disrupting flowering and seed production cycles, and increasing the frequency and intensity of extreme weather events. Invasive species and pathogens can outcompete native Lamiaceae species, disrupt ecosystem dynamics, and spread diseases that threaten plant health. To mitigate these threats and conserve Lamiaceae plants, proactive conservation measures such as habitat restoration, protected area

establishment, sustainable harvesting practices, ex-situ conservation, and public awareness campaigns are essential. Collaborative efforts involving governments, conservation organizations, researchers, local communities, and stakeholders are necessary to safeguard the biodiversity and ecological integrity of Lamiaceae plants for future generations.

2. LITERATURE REVIEWS

By conducting this literature study, the researchers attempted to identify potential novel malaria treatments derived from plants in the Lamiaceae family. To back up this article, we looked for research in the scientific literature that discussed the traditional uses, antiplasmodial activity, and active antimalarial chemicals of plants in the Lamiaceae family. Results: Many plants in the Lamiaceae family have a long history of use as a malaria treatment. An extensive literature review reveals that several of these plants have antimalarial effects of varying strengths, whether tested in vitro against *Plasmodium falciparum* or in vivo against *Plasmodium berghei* in mice. The Lamiaceae family of plants has forty potent antimalarial chemicals that may one day be developed into novel antimalarial medications. Traditional use as malarial drugs in different countries, numerous plant extracts with antimalarial activity, and many active antimalarial compounds isolated from plants in the Lamiaceae family all point to the family as a source of plants with antimalarial activity; however, these plants still require additional research before they can be considered as antimalarial drugs. [9]

The researchers included “*Thymus serpyllum*, *Melissa officinalis*, *Rosmarinus officinalis*, *Origanum vulgare*, *Mentha longifolia*, *Ocimum basilicum*, *Teucrium chamaedrys*, and *Sideritis scardica*”, all of which are members of the Lamiaceae family and used in herbal teas made in the Sharri Mountains area. We used gas chromatography–mass spectrometry and gas chromatography–fluorescence imaging to determine the chemical make-up of the essential oils extracted from these plants. We were interested in learning more about the profiles of the volatile compounds that give each oil its unique aroma and flavor. The purpose of doing Principal Component Analysis (PCA) was to classify the plant species based on their chemical makeup. The patterns of volatile components were found to be characteristic of the Lamiaceae family based on the experimental findings. The taste and therapeutic properties of these plants are attributed to monoterpenes and sesquiterpenes, the most prevalent categories of volatile components. The four main clusters of these examined species were determined via principal component analysis (PCA) of the data. [10]

The Lamiaceae family of plants includes several that have long histories of medicinal usage. Some of the secondary metabolites found in this class have also shown intriguing biological activities. Our research focused on the phytochemicals of Lamiaceae plants, which have traditional medicinal uses in the Aligudarz area of Lorestan province. Here, the years 2018 and 2019 saw the systematic collection and identification of plant species. Through informed consent semi-structured interviews with local informants, we sought to understand the traditional and practical usage of the plants that were gathered. Alkaloids, flavonoids, saponins, tannins, anthraquinone, and glycosides were among the substances that were tested for using phytochemical analysis. We were able to identify 25 different plant species, representing 13 different genes. Common use for these plants included alleviating cold symptoms, easing gastrointestinal issues, and enhancing taste. A total of 25 plant species were studied; 23 of these species contained tannin, 22 showed positive reactivity to flavonoids, 4 to alkaloids, and 1 to saponins. The results of this study shed light on how traditional medicine makes use of secondary metabolites to improve people's health. The plants mentioned in this article have the makings of novel medicines. [11]

Members of the Lamiaceae family of plants are highly prized for their fragrant, medicinal, and decorative qualities. Essential oils extracted from many of these plants have use in both conventional and alternative medicine, as well as in the food, cosmetics, and pharmaceutical industries. The most common plants used in traditional Uzbek medicine for “wounds, gastritis, infections, dermatitis, bronchitis, and inflammation” are members of the “genera *Hyssopus*, *Leonurus*, *Mentha*, *Nepeta*, *Origanum*, *Perovskia*, *Phlomis*, *Salvia*, *Scutellaria*, and *Ziziphora*”. These plants are found all over the globe. Numerous chemicals and essential oils with potential medical and commercial uses have been isolated from these plants via rigorous chemical analysis. The fragrant Lamiaceae species found in Uzbekistan are the focus of this literature review, which aims to provide a critical overview of the research on their traditional usage, ethnopharmacology, biological activity, and essential oil composition. [12]

Medicinal plants have emerged as a promising new therapeutic option due to the many negative side effects of manufactured pharmaceuticals. One of the most formidable adversaries of contemporary medicine, pain is a worldwide public health concern that has a significant influence on people's quality of life and a large financial effect. About 80% of the global population uses plants as antinociceptive or analgesic medications in traditional medicine. Numerous plants in the Lamiaceae family have biological and medicinal uses, making it one of the most significant herbal families. The analgesic activity, potential active chemicals, and action mechanisms of plants belonging to the Lamiaceae family are all included in this research. Based on the information presented in this study, researchers may better understand the role of Lamiaceae plants in pain modulation, which might lead to the future isolation of active chemicals and the development of marketable pharmaceutical drugs derived from these plants. [13]

With an emphasis on promising technological innovations with a repellent, insecticide, and larvicide action mechanism, this study aims to conduct a survey of some recent works related to the Lamiaceae family that could lead to the

development of herbal medicines for the control of diseases transmitted by *Aedes aegypti*. A synthesis of scientific and ethnobotanical literature using Portuguese, English, and Spanish sources formed the basis of this essay. The results demonstrated the possibility of creating herbal remedies that are larvicidal, insecticidal, and repellent for Lamiaceae species. These remedies would be highly toxic to insects but very safe for animals, and they would be easy to get, work with, and apply. They would also be economically viable and have no cumulative effects on humans or other animals. In order to formulate repellents and other products for vector control, it is necessary to determine the most acceptable quantities of phytoconstituents from extracts or essential oils. The following studies assist make this process more feasible. [14]

Reviewing a small number of Lamiaceae plants from Karnataka with therapeutic potential was the goal of the current research. This group of plants includes herbaceous plants and shrubs, many of which have pleasant aromas. Some species are able to withstand the hot summers by producing a significant quantity of essential oil, which makes them widespread in Mediterranean regions. This family includes plants such as “Anisomeles, Colebrookea, Coleus, Hyptis, Leonotis, Leucas, Mentha, Ocimum, Oreganum, and Salvia, among others”. Their medicinal, aromatic, culinary, and decorative uses are significant. Among the medicinal components include organic acids, tannins, saponins, and a powerful scented essential oil. Steam distillation is used to extract the oil. Aromatherapy makes use of the oil for its calming properties. Anxieties, antispasmodic, antifungal, antibacterial, anti-inflammatory, and antiseptic are just a few of the benefits of these herbs. [15]

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The inorganic ion content of four medicinally significant species—*Anisomeles malabarica*, *Hyptis suaveolens*, *Leucas aspera*, and *Ocimum americanum*—belonging to the Lamiaceae family were examined in samples taken from Maravanmadam, Tuticorin, Tamilnadu, India. Both wild plant species and those raised in containers had their nutritional quality assessed. Additionally, the inorganic ion content of soils that were obtained from both the field and the pots was examined. The leaves of plants that were grown had higher concentrations of ions such K^+ , Ca^{2+} , and Mg^{2+} , but lower concentrations of Na^+ . Cultivated samples also had a higher K^+/Na^+ ratio. Soil samples taken beneath the planted plant species also showed increased amounts of the ions described before. [17]

Essential oils extracted from the most widely cultivated plant species in Serbia were the focus of this investigation into their chemical composition and antioxidant capabilities. The essential oils (EOs) were extracted from a variety of medicinal and aromatic plants belonging to the Lamiaceae, Asteraceae, Apiaceae, and Cupressaceae families. These plants include “*Mentha x Piperita*, *Ocimum basilicum*, *Origanum majorana*, *Origanum vulgare*, *Salvia officinalis*, *Satureja hortensis*, *Satureja montana*, and *Thymus vulgaris*; *Ehinacea purpurea* and *Matricaria chamomilla*; *Anethum graveolens*, *Carum carvi*, *Foeniculum vulgare*, *Petroselinum crispum*, and *Pimpinella anisum*; and *Juniperus communis*, Cupressaceae, and *Juniperus communis*, respectively.” The essential oils were isolated using hydrodistillation (HD), and then they were analyzed using gas chromatography–mass spectrometry (GC–MS) for terpene profiles and yield. The DPPH and ABTS⁺ radical scavenging activities were tested in vitro for each essential oil. As a last step, we ran the experimental data on the EOs' antioxidant activity and composition using principal component analysis (PCA). This revealed that the chosen plant species had unique answers to the questions we posed. To further process more EO candidates using developing extraction methods and to employ EOs as natural meat product additives, our study serves as a screening tool. [18]

3. CONCLUSION

The Lamiaceae family stands out as a remarkable group of plants with diverse morphological, ecological, and economic attributes. From the aromatic herbs used in culinary dishes to the medicinal properties of their essential oils, Lamiaceae plants have significant cultural importance and play vital roles in ecosystems worldwide. However, they face conservation challenges due to habitat loss, overexploitation, climate change, and invasive species. Efforts to conserve and sustainably manage Lamiaceae species are essential to ensure their survival and continued benefits to society. Collaboration among researchers, conservationists, policymakers, and local communities is paramount to address these threats and promote the conservation of Lamiaceae plants for future generations. By recognizing the value of these plants and implementing effective conservation strategies, we can safeguard their biodiversity and ecological contributions while preserving their cultural heritage and economic significance.

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