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*Editorial*

# It Runs in the Family: The Importance of the Lamiaceae Family Species

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Medicinal and aromatic plants (MAPs) are becoming increasingly popular in industry, education, agriculture, and health disciplines due to their extensive collection of bioactive chemicals that enhance biological activity in vitro and in vivo. This trend is occurring because MAPs secondary metabolites contain significant antioxidant, anti-inflammatory, antibacterial, antiviral, and anticancer properties and biological activities that outperform many regularly used both synthetic and natural antioxidants [1,2]. These features are due to the abundance of various component groups (phenols, flavonols/flavonoids, alkaloids, polypeptides, vitamins, catechins, phytoestrogens, carotenoids, chlorophyll, minerals, etc.).

The Lamiaceae (Labiatae) family is one of the most significant groups of flowering plants, with a diverse range of species with ecological and medicinal applications. They are primarily herbs and shrubs with a fragrant perfume and a high level of beneficial substances used in natural therapy. Lamiaceae is a significant plant family with 250 genera and over 7000 species. The major genera in this family include *Salvia*, *Scutellaria*, *Stachys*, *Plectranthus*, *Hyptis*, *Teucrium*, *Thymus*, *Vitex*, and *Nepeta*. The most well-known examples include thyme, mint, oregano, basil, sage, savory, rosemary, hyssop, and lemon balm, all of which are aromatic spices, as well as a few others with more limited applications [3]. Lamiaceae species are diverse and widely distributed across several environments but are particularly abundant in the Mediterranean basin [4]. Species from this family are of enormous economic value on a global scale, having numerous applications, including food, cosmetics, flavoring, perfumery, pesticides, and pharmaceuticals [5].

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The present Special Issue "It Runs in the Family: The Importance of the Lamiaceae Family Species" compiles 11 original research articles addressing the recent developments in growing plants in soilless culture, i.e., hydroponics and aquaponics, the changes on plants secondary metabolites under environmental stressors and cultivation practices, landrace maintenance and sustainable agriculture, the effective way of individual compounds identification and extraction methods, as well as the preservative role of essential oils (EOs) and natural compounds on fresh produce and stored grains. The present Special Issue contains scientific papers of high-quality standard coming from several prestigious and renown research groups.

The collection provides insights on the plant extracts and natural compound composition and their role in human health by inhibiting scavenging reactive oxygen species (ROS), stimulating the production of melanin, and absorbing UV radiation. Tsitsigianni et al. [6] investigated the biological activities of different extracts/infusions from ten Lamiaceae species with a rich phytochemical profile, exploring the cytotoxic, photoprotective, antioxidant, and wound-healing properties of different compounds. In that study, five compounds were isolated and identified through NMR spectra, namely salvianic acid A, rosmarinic acid, salvianolic acid K, luteolin-3-O-D-glucuronide, and hispidulin-7-O-D-glucuronide, introducing their photoprotective and non-cytotoxic roles as well as providing a better insight into *Salvia officinalis* and its bioactive constituents. In another study,

Tomou et al. [7] investigated the metabolic profiles of the infusions of four *Stachys* members (*S. candida*, *S. chrysantha*, *S. leucoglossa* subsp. *Leucoglossa*, and *S. spinulosa*) through NMR and HPLC-PDA-MS analyses, detecting 26 compounds belonging to flavonoids, phenylethanoid glycosides, and phenolic acids. Among them, chlorogenic acid was identified in all samples as one of their main metabolites. Innovative inputs of this study were reports for the first time on the metabolic characterization of *S. spinulosa* and discusses the chemotaxonomic significance of such findings.

Standard techniques for extracting EOs from plants include cold pressing, hydrodistillation, and steam distillation, but these technologies have limitations, including extended extraction durations, high energy requirements, and solvent usage. Gavrila et al. [8] investigated the combination of ultrasound and microwave techniques to enhance the thyme EO extraction. It was found that using ultrasound pre-treatment and microwave extraction processes, the extraction time was reduced by 72% compared to conventional hydrodistillation. The benefits of using ultrasound pre-treatment revealed a 23% increase in EO content when compared to extraction without pre-treatment.

Fresh produce preservation remains a challenge, garnering researchers' interest in the postharvest sector for alternative solutions due to uncontrolled spoilage and customer concerns about synthetic food safety. Natural preservative means, including Eos, are attracting interest nowadays, being easily accessible, environmentally safe, often less expensive, and less dangerous for non-target organisms than chemical treatments. In a study of Tzortzakis [9], *Origanum dictamnus* EOs were applied for the preservation of pepper fruits against a widespread postharvest fungus, *Botrytis cinerea*, indicating a 6-day lasting effect of the EOs vapor application on fresh produce preservation. In contrast to sanitary dips, vapor treatment proved to be more effective in pepper fruit preservation. However, on top of the antimicrobial properties of the EOs, fruit quality and safety are also fundamental. To that direction, Xylia et al. [10] evaluated the effectiveness of EOs of *Lavandula angustifolia* Mill. and *Rosmarinus officinalis*, their possible synergistic effects of the EO mixture, and the role of their common main EO component (eucalyptol) for the preservation of cucumber fruits. In that study, the appropriate EO levels were highlighted to avoid any oxidative stress to the fresh commodities, and the synergistic role of the different EO components was addressed in comparison to the main component, providing new insights in natural-based sanitation solutions.

Fresh produce preservation is undoubtedly a challenge, but equally challenging is the stored grain, including *Avena sativa* (L.), *Hordeum vulgare* (L.), *Sorghum bicolor* (L.), *Triticum aestivum* (L.), and *Zea mays* (L.), as several opportunistic pests cause significant losses. To that sense, Plata-Rueda et al. [11] evaluated the *Origanum vulgare* EOs against the stored product beetle, *Sitophilus granaries*, and revealed that *O. vulgare* EOs affect different biological functions in the insect, altering the behavioral pattern in terms of walking distance and resting time, displaying repellency and respiration rates, and insect survival. This represents a first step towards green pesticide innovation, opening new possibilities for pest management in storage.

Plant growth condition and the cultivation practices are important for a successful yield and quality of fresh commodities, with soilless systems being superior towards field conditions. In a study of Hazrati et al. [12], the optimal mineral levels and harvesting time for three *Mentha* species were determined, indicating that increased mineral levels affected positively yield but the increased nitrogen concentration in nutrient solution had a negative effect on specific quality parameters, such as higher $NO_3^-$ content, especially at the third harvest time. Therefore, it is important to tailor the hydroponic nutrient solutions to specific plant species and environmental conditions for achieving optimal yields and quality in commercial mint cultivation. Another approach for sustainable crop cultivation is aquaponics, which is considered a system that can use the water-containing residues from fish production for producing plants. Albadwawi et al. [13] investigated the basil (*Ocimum basilicum* L.) growth in aquaponics compared to soil systems, indicating aquaponics as a sustainable system for both basil growth and increased antioxidant capacity

of the plants when compared to conventional greenhouse cultivation, as plants were subjected to water stress in aquaponics but enhanced their biochemical profiles.

During crop production, not only environmental conditions (heat, drought, wind, etc.) and biotic conditions (pathogens, insects, etc.) but also cultivation practices (including fertilization, irrigation, variety, etc.) can affect the crop yield and performance of plants. In a study by Chrysargyris et al. [14], it was determined the impact of the cropping system (conventional *versus* organic) and irrigation regime (full *versus* deficit irrigation) on *Melissa officinalis*. Results of this work demonstrated that deficit irrigation is an environmentally friendly approach that might be used in both conventional and organic *Melissa officinalis* cropping systems, with the goal of reducing irrigation water use while compensating for reduced herb yields with higher essential oil and polyphenol content. In another study with water management efficiency, Yousefzadeh et al. [15] evaluated soil water availability and effects of developmental stages of *Thymus armeniacus* and *T. kotschyanus* under water shortage, concluding that cultivating *T. armeniacus* with adequate water availability leads to higher yields. Under water scarcity, *T. kotschyanus* is the preferred choice due to its drought tolerance, and selection of cultivars with resistance to abiotic or biotic stress factors is important for crop production.

Another important issue raised in this Special Issue is the environmental and socioeconomic dimensions of the MAPs, focusing on the Lamiaceae family and exploring the related local knowledge and cultural practices that influence their utilization for various purposes. Ivanova et al. [16] investigated the Lamiaceae diversity in home gardens, and semi-structured interviews focused on the cultivation, collection, and utilization practices common among elderly inhabitants in rural Bulgaria. It was highlighted that home gardens are important pools of plant genetic resources that should be preserved and further explored in the frame of the multitude of benefits provided by these plants, while traditional culinary practices were found to sustain the diversity of local forms (landraces).

This collection of high-level scientific publications aims to stimulate discussion and explore the potential of MAPs of the Lamiaceae family and their EOs in ecofriendly preservative means and uses in different industrial sectors with optimized growth conditions, extraction methods, and applications. Soilless cultivation methods can be introduced for other medicinal, aromatic, or culinary species of ethnobotanical interest. These species may have diverse bioactive capabilities that are not yet fully understood or utilized. Additionally, farmers need to optimize all elements that affect yield and produce quality in order to meet the high customer demand for high-quality food.

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