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HEALING HERBS: A DEEP DIVE INTO THE LAMIACEAE FAMILY

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ABSTRACT

Lamiaceae, commonly referred to as the mint family, represents a significant family within the order lamiales, encompassing 236 genera and over 7,000 species distributed globally. This family is also known by the alternative name Labiatae. Ranking as the sixth largest family of flowering plants. Lamiaceae holds economic and cultural significance across various regions. Historically, it was thought to be closely related to Verbenaceae; however, research conducted in the 1990s revealed that numerous genera previously classified under Verbenaceae are more accurately placed within Lamiaceae. While the name Labiatae remains an acceptable alternative, the term "Lamiaceae" is predominantly used by botanists today. Members of the Lamiaceae family display a remarkable array of ecological adaptations, thriving in environments ranging from arid deserts to lush forests. Each species within this family is characterized by a unique and intricate composition of bioactive compounds, with each constituent playing a role in the overall bioactivity. The significance of these plants lies in their ability to produce a diverse array of secondary metabolites, which exhibit potent antibacterial, antioxidant, anti-inflammatory, anti-microbial, anti-viral and anti-cancer properties. For instance, *Rosmarinus officinalis*, known as the herb of remembrance, has been recognised for its ability to enhance memory, alleviate anxiety and depression, and improve sleep quality. This review seeks to examine the existing bioactivities of the Lamiaceae family, aiming to provide a comprehensive foundation of knowledge that could enhance the understanding and utilization of the family as safe therapeutic alternatives.

INTRODUCTION:

Plant species of the Lamiaceae family are plants that are found in the surrounding environment. These plants are generally herbs and shrubs, most of which are ground cover. The stems and branches are rectangular, and the leaves are opposite or crossed opposite each other, with no supporting leaves. Compound flowers and petals do not fall, numbered 4-5, and the flower crown is attached in the shape of a lip. The Lamiaceae family is a plant from the mint tribe that has a distinctive odour for each species. This plant is also used as a source of fragrances, essential oils, spices, and cooking spices. Types of plants from the Lamiaceae are rich in phytochemical compounds and secondary metabolites. Besides being used as a medicinal plant, and plants of Lamiaceae also have various kinds of biological activity plants [1-3]. According to a number of studies, plants contain

bioactive substances like terpenoids, alkaloids, glycosides, phytohormones, phenolic, and phenylpropanoids that aid in the creation of phytotherapeutics. Additionally, natural products may be a good substitute for pharmaceuticals that target microbes that are resistant to conventional antibiotics. Because of their biological qualities, a number of aromatic plant species in the Lamiaceae family are used in traditional medicine as well as in the food and pharmaceutical industries. In addition to strengthening the central nervous system and stimulating blood circulation and digestion, they are also employed as diuretics, carminatives, expectorants, antispasmodics, and tonics. In this family, oregano, rosemary, thyme, and sage are the most widely used plants [4-6]. They are also abundant in other chemicals that have helped with taxonomic classifications in addition to their therapeutic uses. The six most well-known colloquial names for aromatic spices are thyme, basil, oregano, rosemary, sage, and lemon balm. This range of bioactive substances gives Lamiaceae characteristics like antibacterial, insecticidal, fungicidal, and antioxidant, which can lead to a collection of possible pharmacological and economic benefits [7,8]. One of the plants that are efficacious as a medicinal plant is the Lamiaceae family. Various chemical compounds contained in species in the Lamiaceae family are flavonoids, triterpenoids, essential oils, alkaloids, tannins, and saponins which are useful for treating various diseases so that they can be used as medicinal ingredients. Generally, the Lamiaceae contains pain-relieving, diuretic, tonic, anti-fungal, anti-microbial, anti-inflammatory, and anti-infection properties. Extracts from plants have the potential to be further analyzed so as to produce products that have the potential to be used as drugs. Based on the results of the review, the compounds contained in plant extracts have the potential as anti-oxidants, anti-microbials, anti-inflammatory, and others [9]. These are some of the plants of Lamiaceae family, they are Mentha (mint), *Salvia officinalis* (common sage), Basil (*Ocimum basilicum*), Rosemary (*Rosemary officinalis*), Oregano (*Origanum vulgare*), Thyme (Thymus vulgaris), Lemon balm (*Melissa officinalis*), Lavender (*Lavandula angustifolia*), Majoram (*Origanum majorana*). Many of the plants belonging to the Lamiaceae family show a wide range of biological activities which are having the benefits to human life [10,11].

Figure 1: Plants to belongs Lamiaceae

Bioactivities of Lamiaceae family

Anti-oxidant activity: Antioxidants are compounds that can inhibit or prevent the oxidation of lipids, a process that is often accelerated by excessive oxygen radicals stemming from environmental influences or pathogens. These are the substances which may be derived from the natural sources or synthesized artificially, play a crucial role in the food industry as they serve as preservatives in various products, effectively slowing down or preventing spoilage due to oxidative processes. Furthermore, anti-oxidants are of significant importance in the realms of biochemistry and medicine, as they

possess the ability to counteract the detrimental effects of oxidation on animal tissues. There has been a notable increase in the pursuit of natural products with antioxidant capabilities in recent years, driven by concerns over the toxic side effects of synthetic alternatives. Aromatic and medicinal plants are deemed significant natural sources of antioxidant agents, as their secondary metabolites function to inhibit the production of free radicals. Research into the anti-oxidant properties of various species within the Lamiaceae family has been ongoing and extensive. It is crucial to recognize that plant species, farming methods, and processing techniques can all have a substantial impact on the chemical makeup and effective inhibitory concentrations of essential oils when assessing their antioxidant qualities. Essential oils having a wide range of constituents, such as terpinene and significant amounts of phenolic compounds, typically have higher anti-oxidant action. Additionally, essential oils with higher concentrations of monoterpenes and/or phenolic sesquiterpenes have been acknowledged for their improved anti-oxidative qualities [11-14].

Anti-inflammatory activity: Antigen-antibody type interactions, physical trauma, viral pathogens, and other biological stimuli all contribute to the sequential process of inflammation. Superoxide anions, hydroxyl radicals, and hydrogen peroxides are examples of reactive oxygen species (ROS) responses that occur throughout the inflammatory process. Activated dendritic cells, neutrophils, and macrophages release these. In order to limit this aggressive effect on the body, it is required to look for new anti-inflammatory drugs, primarily of vegetable origin, as the inflammatory process and its chain of development have presented relevance. It is important to note that some species in this branch, such as the folk medicine - used *Hyptis spicigera*, have inflammatory qualities. Even today many people, foremost in rural areas, depend on herbal medicines to treat inflammation related conditions such as rheumatism, muscle swelling, cut wounds, accidental bone fractures, insect bites etc. Discovery of natural inflammatory agents and further development of novel dietary supplements with anti-inflammatory activities is of considerable public health relevance, since malnutrition is linked to inflammation, aging, and other degenerative processes. The species of the family Lamiaceae are a great source of phenolic compounds of multidirectional biological activity, including anti- inflammatory ones. The main classes of phenolic compounds reported to be present in the family Lamiaceae are phenolic acids, mainly caffeic and rosmarinic acid and flavonoids. The species of the family Lamiaceae known to possess anti-inflammatory activity are Mexican giant hyssop (*Agastache mexicana*) [15-18].

Anti-microbial activity: The Lamiaceae family holds considerable economic importance, particularly within the culinary sector, due to its utilization as culinary herbs. This significance has led to an ongoing exploration for new antimicrobial agents derived from plant secondary metabolites, which can enhance the shelf life of food products. Essential oils obtained from the aerial parts of *Teucrium trifidum* and *Teucrium africanum* were characterised by the presence of sesquiterpene hydrocarbons alpha and beta-cubebene, respectively. The antibacterial efficacy of these essential oils was evaluated, revealing that *T. africanum* essential oil exhibited a Minimum Inhibitory Concentration (MIC) of 0.16mg/ml against the gram-positive bacterium streptococcus. Similarly, *T. trifidum* essential oils demonstrated against staphylococcus aureus , another gram-positive bacterium with a MIC of 2 mg/ml [19-21].

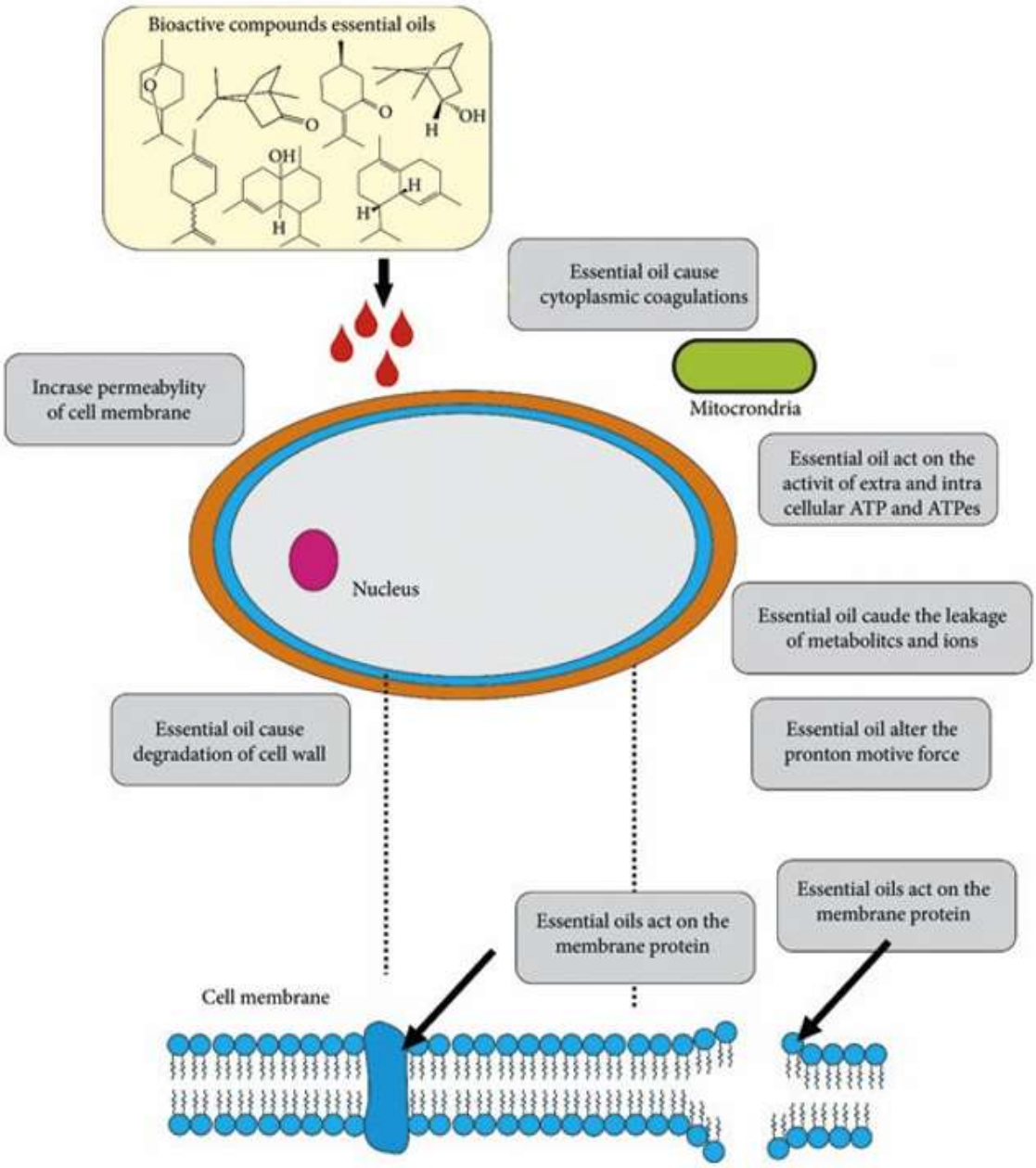

Figure 2: Mechanism of action

Anti-fungal activity: When it comes to food, fungi can develop mycotoxins and ruin the nutritional content of grains during storage, putting humans at considerable risk from fungal illnesses. Consequently, it's important to recognize the numerous studies employing essential oils with antibacterial properties against fungus from the Lamiaceae family .When the essential oils of *Thymus capitatus*, *Satureja thymbra*, and *O. vulgare* were analyzed, the primary ingredients were carvacrol (82.48%), p-cymene (5.00%), and γ-terpinene (2.62%). They were tested against two phytopathogenic fungi (*Penicillium* spp. and *Aspergillus niger*) that were isolated from bread slices that had been left out at room temperature. The findings showed that the colony surface area was dramatically decreased ($p < 0.05$) by the use of essential oils. The food industry and bread recipes can utilize oregano (*O. vulgare*), thyme (*Thymus capitatus*), and pink savory

(*S. thymbra*) due to their antibacterial properties [22,23].

Anti-angiogenic and anti-tumoral activity: Angiogenesis, a normal and vital physiological process, is the creation of new blood vessels from pre-existing ones in a non-pathological context. However, this mechanism also contributes to the fundamental phase of a tumor's transition from a dormant to a malignant state. Angiogenesis inhibitors are therefore used in cancer treatment. Recently, some essential oils have been proposed as non-toxic anti-angiogenic agents. Origanum EOs can inhibit angiogenesis and the viability of cancer cells, one of the components of the EOs is carvacrol [24,25].

Blood cholesterol and lipid lowering activity: An increase in blood cholesterol and triglycerides is another factor contributing to CVD. It could lead to atherosclerosis, a condition in which fat and cholesterol particles build up and harden in the arteries, blocking blood flow. Numerous heart and coronary problems, such as stroke and vascular illnesses, are brought on by this. The antihyperlipidemic or hypolipidemic effect refers to a substance's capacity to break down these hardened fat deposits. It can also aid to increase the "good" HDL and lower the levels of triglycerides such as cholesterol and low-density lipoprotein (LDL). The many plant parts of the Lamiaceae family can considerably reduce the incidence of CVD since they are high in polyphenols and have an antihyperlipidemic impact. The optimal dosage for treating hyperlipidemia in rats has been found to be 40 mg/kg bodyweight of the dried hydroalcoholic extract of *Dracocephalum kotschyi* Boiss, which also considerably reduces the risk of father oscleross. Secondary metabolites are plentiful in the ether and ethanolic extracts of Leucas aspera, which are employed in traditional medicine to treat a wide range of illnesses. In rats with induced hyperlipidemia (dexamethasone treatment), the extract was efficient in a dose-dependent way; the steroidal phytochemical was shown to replace the synthesis of triglycerides and cholesterol, which further resulted in a hypolipidemic impact [26-28].

Anti-coagulant and anti- thrombolytic activity: The thromb information process, which further transforms fibrinogen into fibrin, is triggered by the breakdown of proteins in blood clotting, a complex sequence of events. Factor VIII with platelets, which facilitates the blood coagulation or clotting process, sets off this series of events. Anti-coagulants stop clots or thrombus from developing in the tissues and arteries. A few plants in the Lamiaceae family have been found to exhibit anticoagulant properties, showed the thrombolytic activity of methanol extract, solvent fractions (petroleum ether, chloroform, and carbon tetrachloride), and aqueous fractions of *Clerodendrum infortunatum* L. leaves using a clot lysis assay. The carbon tetrachloride and chloroform fractions showed the highest and least percentage of clot lysis. *Thymus vulgaris* L., *Rosmarinus officinalis* L., and *Salvia officinalis* L. leaf extracts (200-1000 μg/ml) show thrombolytic activity in a dose-dependent manner; their thrombolytic potential can be arranged in the order *Thymus vulgaris* L. > *Rosmarinus officinalis* L. > *Salvia officinalis* L. [29-31].

Anti-allergic activity: The Lamiaceae family has a wide range of medicinal applications due to its abundance of species, which makes it a significant pharmacological family. The great range of physiologically active components in this plant family is thought to be the cause of the diversity. Every species has a variety of phytochemicals that contribute to its bioactivity [32-34].

Diuretic activity: Significant diuretic effect has also been shown by the ethanolic and aqueous extracts of *Coleus amboinicus* Lour

and Ajuga Integrifolia Buch.-Ham.exD. The diuretic effect and electrolyte excretion effect of don, a perennial herbaceous plant of the Lamiaceae family, were similar to those produced by the diuretic drug furosemide. Its aqueous and 80% methanolic extracts showed an increase in urine volume. *Clerodendrum myricoides* Host. has been used as a traditional remedy for a number of ailments, including edema and urinary retention. Ethyl Acetate, chloroform, and alcohol, as well as the hydromethanolic extract of the plant's leaves and roots, demonstrated diuretic activity in rats *in vivo*; the hydromethanolic extract demonstrated a higher diuretic than furosemide (100 mg/kg). According to reports, this extract has very little cell cytotoxicity and has higher solubility for pharmacologically active ingredients such as flavonoids, tannins, terpenes, phenols, saponins, and others [35-40].

Future prospects of Lamiaceae family

- The Lamiaceae family, also known as the mint family, is renowned for its diverse range of bioactive compounds making it a promising area for future research and development. The Lamiaceae family faces several diseases and pests that can impact their growth and productivity. Future research is focusing on developing sustainable and effective solutions to manage these issues.
- Lamiaceae derived from the bioactive compounds such as essential oil, are being explored as natural alternatives to synthetic pesticides. These compounds exhibit properties like neurotoxic effects, growth regulatory effects making them effective in pest management.
- Plants like basil, thyme, and summer savory from the Lamiaceae family contain anti- inflammatory, antibacterial, antiviral and anticancer properties.
- The family plants are being studied for their resistance against biotic and abiotic stresses such as drought and salinity.
- Essential oils from Lamiaceae plants are widely used in cosmetics and perfumes due to their fragrant properties.
- The antimicrobial properties of Lamiaceae plants make them ideal for food preservation.

CONCLUSION

Depending on the climate, location, and growing system, Lamiaceae species and thus their essential oils may have unique characteristics. Certain biological and chemical characteristics thus have a tendency to alter, indicating considerable promise, particularly in relation to therapeutic uses. They have been used to treat some ailments because of their antioxidant, anti-fungal, anti-inflammatory properties. Other Lamiaceae species can also be used for insect control, environment cleanup (phytoremediation), and thermal protection (green roofs). Given the considerable versatility of this botanical family, further research on its components is necessary since they have a bright future and significant therapeutic potential. The utilization of alternative natural resources for various purposes are thus encouraged by this review, which also adds to future research on Lamiaceae.

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