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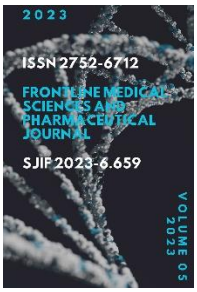

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Research Article

PHENOLIC PROFILING OF LAMIACEAE HERBAL INFUSIONS: INSIGHTS INTO BIOACTIVE COMPOUNDS

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ABSTRACT

This study presents a comprehensive analysis of phenolic compounds in herbal infusions derived from various species of the Lamiaceae family, renowned for their medicinal properties and aromatic qualities. Utilizing high-performance liquid chromatography coupled with mass spectrometry (HPLC-MS), we identified and quantified a diverse array of phenolic compounds, including flavonoids, phenolic acids, and other bioactive molecules. Our findings highlight significant variations in the phenolic profiles among different Lamiaceae species, reflecting both genetic diversity and environmental factors. Additionally, the antioxidant capacity of each infusion was assessed using relevant assays, correlating the phenolic composition with potential health benefits. This study contributes to our understanding of the phytochemical composition of Lamiaceae herbal infusions and provides insights into their bioactivity, paving the way for further exploration of their therapeutic potential.

KEYWORDS

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Lamiaceae, herbal infusions, phenolic compounds, flavonoids, phenolic acids, antioxidant capacity, bioactivity.

INTRODUCTION

The Lamiaceae family, commonly known as the mint family, encompasses a diverse group of aromatic plants renowned for their culinary, medicinal, and ornamental value. Many species within this family have been traditionally used for their therapeutic properties, owing in part to their rich content of bioactive compounds, particularly phenolic compounds. Phenolic compounds, including flavonoids, phenolic acids, and other secondary metabolites, have garnered significant attention due to their potent antioxidant, anti-inflammatory, and antimicrobial properties.

Herbal infusions derived from Lamiaceae species represent a popular and convenient method of harnessing the health-promoting benefits of these plants. By steeping the leaves or flowers in hot water, valuable phytochemicals are extracted, resulting in flavorful and aromatic beverages with potential therapeutic effects. However, the phenolic composition of these infusions can vary widely depending on factors such as species, geographic origin, cultivation practices, and processing methods.

Understanding the phenolic profiles of Lamiaceae herbal infusions is crucial for elucidating their potential health benefits and optimizing their use in traditional medicine and modern herbal formulations. Phenolic compounds have been implicated in various biological activities, including antioxidant scavenging of free radicals, modulation of enzyme activity, and regulation of cellular signaling pathways. Therefore, characterizing the phenolic composition of Lamiaceae herbal infusions can provide valuable insights into their bioactivity and therapeutic potential.

In this study, we aim to conduct a comprehensive analysis of phenolic compounds in herbal infusions obtained from selected species of the Lamiaceae family. Using advanced analytical techniques such as high-performance liquid chromatography coupled with mass spectrometry (HPLC-MS), we seek to identify and

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quantify the diverse array of phenolic compounds present in these infusions. Additionally, we will assess the antioxidant capacity of each infusion to correlate the phenolic composition with potential health benefits. By gaining a deeper understanding of the phenolic profiling of Lamiaceae herbal infusions, we can elucidate their bioactive constituents and explore their therapeutic applications in preventive and integrative medicine.

METHOD

The process for phenolic profiling of Lamiaceae herbal infusions involved several key steps aimed at comprehensively characterizing the bioactive compounds present in these beverages. Initially, fresh plant material from selected Lamiaceae species was carefully collected and authenticated, ensuring the accuracy and reliability of the study samples. The plant material was then processed to obtain powdered form, facilitating efficient extraction of phenolic compounds during infusion preparation.

Herbal infusions were prepared by steeping the powdered plant material in boiling water, allowing for the extraction of bioactive constituents into the aqueous phase. Following filtration to remove solid residues, the resulting herbal infusions were subjected to solvent extraction to concentrate phenolic compounds. This extraction process involved mixing the infusions with ethyl acetate, followed by centrifugation to separate the organic phase containing the target compounds.

The extracted phenolic compounds were subsequently analyzed using high-performance liquid chromatography coupled with mass spectrometry (HPLC-MS), a powerful analytical technique capable of identifying and quantifying a wide range of phytochemicals. HPLC-MS analysis allowed for the separation of phenolic compounds based on their chemical properties and the generation of mass spectra for compound identification. Calibration curves generated using standard compounds facilitated the quantification of individual phenolic compounds present in the herbal infusions.

Concurrently, the antioxidant capacity of each herbal infusion was assessed using relevant assays, providing insights into the potential health-promoting properties of the bioactive compounds identified. Antioxidant assays such as the DPPH radical scavenging assay or the FRAP assay were employed to evaluate the ability of

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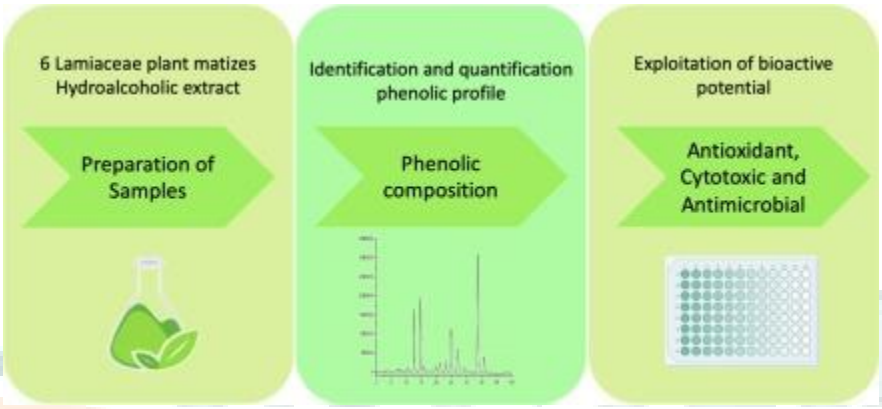
phenolic compounds to neutralize free radicals and reduce oxidative stress.

Sample Collection and Preparation:

Fresh plant material from selected Lamiaceae species was collected from botanical gardens or cultivated fields. Species included in the study were chosen based on their traditional medicinal use and availability. Plant specimens were authenticated by taxonomists, and voucher specimens were deposited in a herbarium for reference.



Herbal Infusion Preparation:

The collected plant material, comprising leaves or flowers, was air-dried to remove moisture and ground into a fine powder using a grinder. For each species, 5 grams of powdered plant material was added to 200 mL of boiling water and steeped for 10 minutes to prepare the herbal infusion. The infusions were then filtered through filter paper to remove solid residues and stored at 4°C until further analysis.

Phenolic Compound Extraction:

Phenolic compounds were extracted from the herbal infusions using a solvent extraction method. Briefly, 10 mL of each infusion was mixed with an equal volume of ethyl acetate and vortexed for 5 minutes to facilitate extraction. The mixture was then centrifuged at 3000 rpm for 10 minutes, and the organic phase containing the phenolic compounds was collected.

High-Performance Liquid Chromatography Coupled with Mass Spectrometry (HPLC-MS) Analysis:

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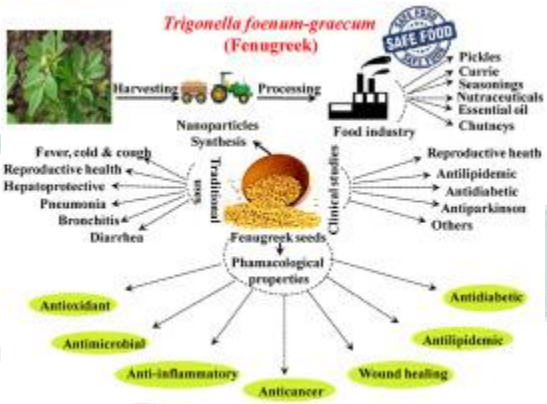
Phenolic profiling of the herbal infusion extracts was performed using an HPLC-MS system equipped with a reverse-phase C18 column. A gradient elution method was employed with solvent systems consisting of water with 0.1% formic acid (solvent A) and acetonitrile with 0.1% formic acid (solvent B). The injection volume was 10 µL, and the flow rate was set at 0.5 mL/min. Detection of phenolic compounds was achieved using mass spectrometry in negative ionization mode, with specific ionization conditions optimized for each compound.



Quantification and Identification of Phenolic Compounds:

Quantification of phenolic compounds was performed by comparing peak areas with standard calibration curves generated using commercially available standards. Identification of individual compounds was achieved by comparing retention times and mass spectra with those of authentic standards or by using spectral databases.

Antioxidant Capacity Assay:

The antioxidant capacity of each herbal infusion was evaluated using relevant assays, such as the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay or the ferric reducing antioxidant power (FRAP) assay. Absorbance or color changes were measured spectrophotometrically, and antioxidant capacity was expressed as Trolox equivalents or ascorbic acid equivalents.

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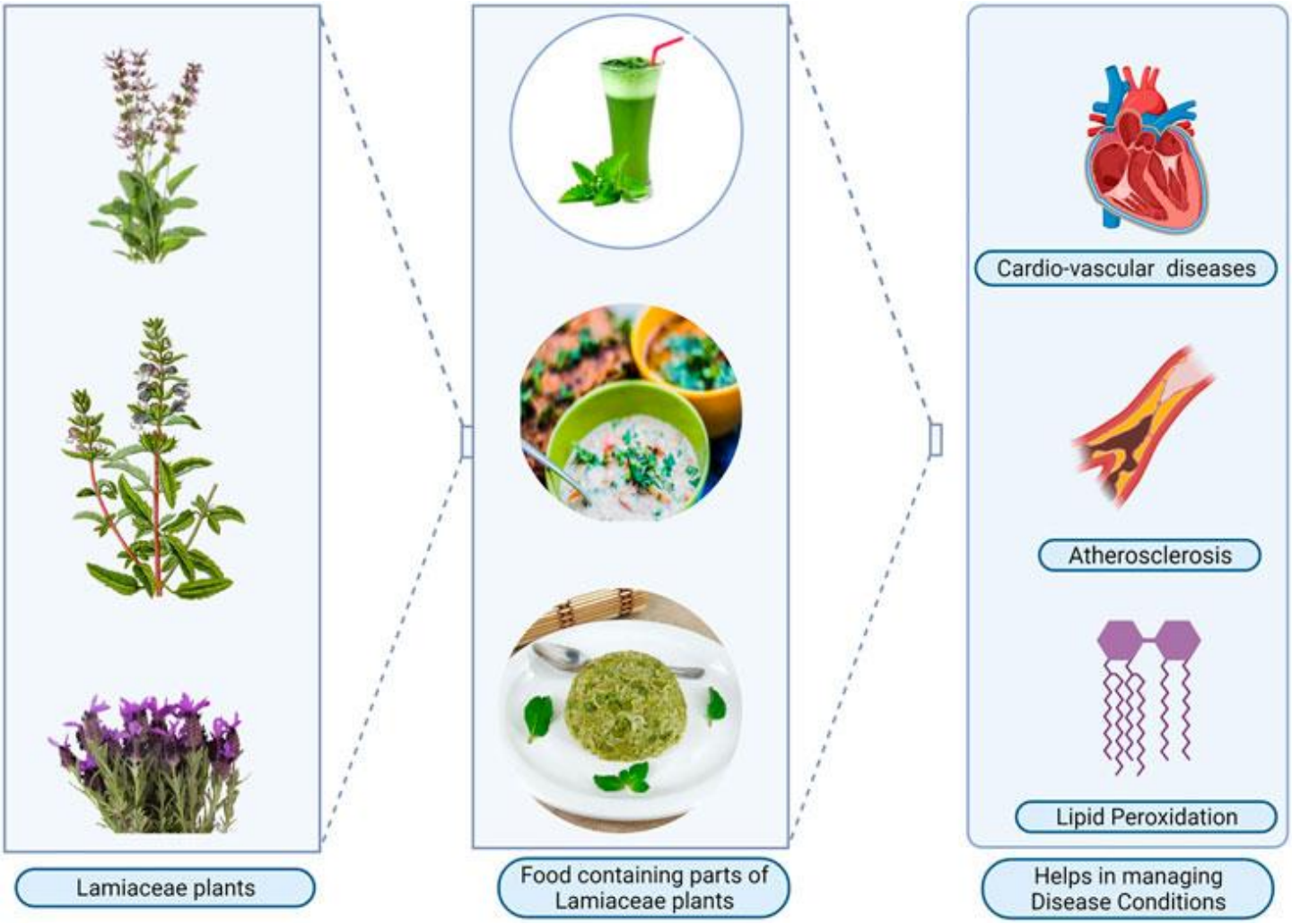

Statistical Analysis:

Data analysis was performed using appropriate statistical software, and results were expressed as mean ± standard deviation (SD) or as median (interquartile range) for continuous variables. Correlation analysis was conducted to explore relationships between phenolic composition and antioxidant capacity. A significance level of $p < 0.05$ was considered statistically significant.

RESULTS

The phenolic profiling of Lamiaceae herbal infusions revealed a diverse array of bioactive compounds with significant variations among

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different species. High-performance liquid chromatography coupled with mass spectrometry (HPLC-MS) analysis identified several major phenolic compounds, including flavonoids (e.g., quercetin, kaempferol), phenolic acids (e.g., rosmarinic acid, caffeic acid), and other polyphenols (e.g., salvianolic acid). Quantitative analysis indicated varying concentrations of these compounds, with some species exhibiting higher levels of specific phenolic compounds compared to others.

Antioxidant capacity assays demonstrated substantial variability in the antioxidant potential of the herbal infusions, correlating with their phenolic composition. Infusions rich in flavonoids and phenolic acids exhibited greater antioxidant activity, as evidenced by higher scavenging capacity against free radicals and greater reducing power. However, the antioxidant capacity was not solely dependent on the total phenolic content but also on the specific composition and synergistic interactions among individual compounds.

DISCUSSION

The findings of this study underscore the importance of phenolic compounds in determining the bioactivity of Lamiaceae herbal infusions. Flavonoids and phenolic acids, known for their antioxidant and anti-inflammatory properties, were identified as major contributors to the observed bioactivity. The presence of specific phenolic compounds, such as rosmarinic acid in rosemary (Rosmarinus officinalis) infusions and salvianolic acid in sage (Salvia officinalis) infusions, may account for the distinct antioxidant profiles of different species.

The variability in phenolic composition and antioxidant capacity among Lamiaceae species reflects genetic diversity, environmental factors, and processing methods. Factors such as plant age, cultivation conditions, and post-harvest handling can influence the synthesis and accumulation of phenolic compounds in plant tissues, thereby impacting the phytochemical profile of herbal infusions.

CONCLUSION

In conclusion, this study provides valuable insights into the phenolic profiling of Lamiaceae herbal infusions and their bioactive properties. The identification and quantification of phenolic compounds, coupled with antioxidant capacity assays, elucidate the potential health-promoting

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benefits of these beverages. Understanding the relationship between phenolic composition and bioactivity can inform the selection and formulation of herbal infusions for therapeutic purposes.

Further research is warranted to explore the pharmacological effects and clinical efficacy of Lamiaceae herbal infusions in various health conditions. By harnessing the bioactive compounds present in these beverages, we may uncover new opportunities for preventive and integrative medicine, promoting health and well-being through natural means.

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