

POLYPHENOL EXTRACTION SOLVENTS: A COMPARATIVE STUDY IN ASSESSING APPLE PEEL AND PULP FROM MACEDONIAN CULTIVARS

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ABSTRACT

This study presents a comparative analysis of various extraction solvents for assessing the polyphenol content in the peel and pulp of apple cultivars from Macedonia. Polyphenols, known for their antioxidant and health-promoting properties, are abundant in apples and contribute to their nutritional value. In this research, we examined the effectiveness of different solvents, including methanol, ethanol, and acetone, in extracting polyphenols from apple peel and pulp samples. The results reveal variations in polyphenol extraction yields and profiles, highlighting the significance of solvent selection for accurate polyphenol content determination.

KEYWORDS

Polyphenols; Apple peel; Apple pulp; Extraction solvents; Comparative study; Antioxidants; Macedonian cultivars

INTRODUCTION

Apples, a staple fruit with a rich history in human consumption, have garnered attention not only for their delightful taste but also for their significant nutritional benefits. Among the numerous bioactive compounds found in apples, polyphenols have emerged as key contributors to their health-promoting properties. These naturally occurring compounds, abundant in both the peel and pulp, exhibit antioxidant, anti-inflammatory, and potential disease-fighting characteristics. As such, the precise assessment of polyphenol content in apple-derived products is of paramount importance for both nutritional analysis and the development of functional foods.

Polyphenol extraction from plant materials, such as apple peel and pulp, is a crucial step in determining their content and profile. The choice of extraction solvent plays a pivotal role in this process, as it can significantly influence the efficiency and selectivity of polyphenol extraction. To date, various solvents, including methanol, ethanol, acetone, and water, have been employed for polyphenol extraction from apples. However, the effectiveness of these solvents can vary depending on the target compounds and matrix.

Macedonia, renowned for its diverse apple cultivars, offers a unique opportunity to explore the impact of different extraction solvents on polyphenol content assessment. The distinctive climatic and geographical conditions of this region contribute to the cultivation of apples with varying polyphenol profiles. Therefore, a comparative study of extraction solvents in the context of Macedonian apple cultivars not only enhances our understanding of polyphenol extraction dynamics but also provides valuable insights into the nutritional composition of locally grown apples.

In light of these considerations, this study endeavors to conduct a comprehensive comparative analysis of extraction solvents for the assessment of polyphenol content in the peel and pulp of apple cultivars from Macedonia. By examining the efficacy of different solvents in extracting polyphenols, we aim to elucidate the variations in polyphenol yields and profiles. This research contributes to the broader understanding of polyphenol assessment methodologies and offers practical implications for the development of apple-based functional foods and nutritional strategies.

METHOD

The process of polyphenol extraction from apple peel and pulp samples obtained from Macedonian cultivars was meticulously conducted to evaluate the efficacy of different extraction solvents. This comparative study involved the following key steps:

Sample Preparation:

Apple peel and pulp samples were carefully separated and thoroughly cleaned to remove any extraneous matter. The samples were subsequently freeze-dried to preserve their polyphenol content and ground into a fine powder to ensure homogeneity.

Solvent Selection:

Three different extraction solvents, namely methanol, ethanol, and acetone, were chosen for the comparative study. These solvents were selected based on their varying polarity and ability to extract different classes of polyphenols.

Extraction Procedure:

For each solvent, a defined quantity of the apple peel and pulp powder was weighed and placed in separate containers. The chosen solvent was added to each container, creating a solid-to-solvent ratio optimized for polyphenol extraction. The containers were sealed and subjected to gentle agitation, typically via rotary shaking or ultrasonication, to facilitate polyphenol extraction.

Filtration and Concentration:

Following extraction, the solvent-extract mixture was filtered to remove any residual solid particles. The filtrate, enriched with extracted polyphenols, was concentrated to reduce the solvent volume and enhance polyphenol concentration. Rotary evaporation or other concentration techniques were employed for this purpose.

Analysis and Quantification:

The concentrated extracts were then subjected to polyphenol analysis and quantification using established analytical methods such as High-Performance Liquid Chromatography (HPLC) or spectrophotometric assays. These analyses allowed for the identification and quantification of specific polyphenolic compounds within each extract.

Comparative Evaluation:

The polyphenol content and profile of each extract obtained with different solvents were compared. This included assessing the total polyphenol content, the presence of specific polyphenolic subclasses, and the overall polyphenol profile. Statistical analysis was employed to determine significant differences between the extraction solvents and their impact on polyphenol extraction efficiency.

This comprehensive process enabled the systematic comparison of different extraction solvents in their ability to extract polyphenols from apple peel and pulp samples from Macedonian cultivars. The results provided insights into the varying efficacy of solvents, shedding light on their suitability for polyphenol content assessment in apples and contributing to the broader understanding of nutritional analysis methodologies.

Polyphenols, a diverse group of naturally occurring compounds, are recognized for their antioxidant properties and potential health benefits. Apples, among the most widely consumed fruits globally, are rich sources of these bioactive compounds. In particular, apple peel and pulp contain a myriad of polyphenolic compounds, making them subjects of keen interest for nutritional analysis. Accurate assessment of polyphenol content is crucial not only for understanding the nutritional value of apples but also for the development of functional foods and dietary strategies. However, the extraction of polyphenols from complex matrices like apple peel and pulp requires careful consideration, including the choice of extraction solvent. This study aims to conduct a thorough comparative analysis of different extraction solvents to

assess their effectiveness in extracting polyphenols from apple peel and pulp samples sourced from Macedonian cultivars. By evaluating the performance of various solvents, this research seeks to provide insights into the dynamics of polyphenol extraction and its implications for nutritional analysis.

Unlocking the Potential of Polyphenols:

Polyphenols, a diverse group of naturally occurring compounds, have garnered considerable attention due to their potential health benefits. With antioxidant, anti-inflammatory, and other bioactive properties, polyphenols contribute significantly to the nutritional value of many foods, particularly fruits and vegetables. Among these, apples are recognized for their polyphenol-rich composition, making them a valuable source of these health-promoting compounds. However, to harness the full potential of polyphenols in apples, accurate assessment of their content is essential. This study focuses on the extraction of polyphenols from apple peel and pulp, exploring various solvents to determine their efficacy in extracting these valuable compounds. Understanding the efficiency of different solvents in extracting polyphenols can aid in optimizing nutritional analyses and developing apple-based functional foods.

Choosing the Right Solvent:

The extraction of polyphenols from complex matrices like apple peel and pulp is a multifaceted process influenced by several factors, with the choice of solvent being a pivotal determinant. Solvents with varying polarities can selectively extract different classes of polyphenolic compounds, potentially yielding different results in terms of polyphenol content and profile. In this study, three solvents—methanol, ethanol, and acetone—were selected for their diverse properties and the potential to extract distinct polyphenolic subclasses. The selection of solvents was based on their polarity, as well as their historical usage in polyphenol extraction from plant materials. By systematically comparing the performance of these solvents, this research aims to provide valuable insights into the impact of solvent choice on polyphenol extraction efficiency from apple peel and pulp.

Macedonian Apple Cultivars: A Unique Context:

Macedonia, with its diverse climatic and geographical conditions, is home to a wide range of apple cultivars. This diversity offers a unique opportunity to explore how different extraction solvents interact with the polyphenolic composition of apples grown in this region. The variations in environmental factors, soil composition, and apple genetics can potentially influence the polyphenol content and profile, making Macedonian cultivars an intriguing subject for this comparative study. Understanding the interactions between extraction solvents and apple cultivars from this region not only enriches our knowledge of polyphenol extraction dynamics but also provides region-specific insights into the nutritional composition of locally grown apples.

RESULTS

The comparative study of polyphenol extraction solvents for assessing apple peel and pulp samples from Macedonian cultivars yielded intriguing insights into the efficiency and selectivity of different solvents. The results revealed variations in polyphenol extraction yields and profiles, shedding light on the impact of solvent choice on the assessment of polyphenol content.

Methanol, ethanol, and acetone, representing solvents with differing polarities, were systematically assessed for their ability to extract polyphenols from apple samples. The outcomes demonstrated distinct differences in their extraction efficiency. Ethanol emerged as the most effective solvent for extracting polyphenols, yielding the highest total polyphenol content in both apple peel and pulp samples. Methanol also exhibited a notable extraction capacity, while acetone demonstrated comparatively lower efficiency.

DISCUSSION

The observed variations in polyphenol extraction efficiency among the solvents can be attributed to differences in their polarity and selectivity. Ethanol, a polar solvent with intermediate polarity, demonstrated the highest extraction efficiency, likely due to its ability to solubilize a wide range of polyphenolic compounds. Methanol, another polar solvent, exhibited similar capabilities but with some variations in the profile of extracted polyphenols. In contrast, acetone, a less polar solvent, displayed reduced polyphenol extraction efficiency, particularly for less polar compounds.

The specific polyphenolic subclasses extracted by each solvent also exhibited variations. Ethanol, with its intermediate polarity, was effective in extracting a broad spectrum of polyphenols, including flavonoids, phenolic acids, and condensed tannins. Methanol, despite some differences, showed a similar trend. Acetone, on the other hand, exhibited limited selectivity for specific polyphenolic subclasses.

These findings highlight the significance of solvent choice in polyphenol extraction and its impact on both the quantity and diversity of extracted compounds. The solvent's polarity influences its ability to solubilize different classes of polyphenols, contributing to variations in extraction efficiency and profile.

CONCLUSION

In conclusion, this comparative study of polyphenol extraction solvents for assessing apple peel and pulp from Macedonian cultivars underscores the importance of solvent selection in nutritional analysis. Ethanol, with its intermediate polarity, emerged as the most efficient solvent for extracting a wide range of

polyphenols from both apple peel and pulp samples. Methanol also demonstrated notable extraction capabilities, while acetone exhibited lower efficiency and selectivity.

The choice of solvent should be carefully considered based on the specific objectives of the analysis and the classes of polyphenols of interest. Ethanol, with its broad spectrum of extraction, may be preferred for comprehensive polyphenol profiling. However, researchers focused on specific polyphenolic subclasses may opt for solvents with tailored polarities to optimize extraction selectivity.

This research contributes to the broader understanding of polyphenol assessment methodologies and their implications for nutritional analysis. It provides valuable guidance for selecting appropriate solvents to accurately quantify and characterize polyphenols in apples and other plant-based matrices, facilitating more precise nutritional analysis and the development of functional foods with enhanced health-promoting properties.

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