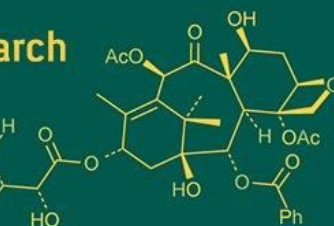
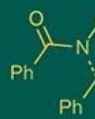
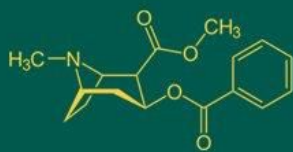


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2022; 6(1): 84-86
www.biochemjournal.com
Received: 12-02-2022
Accepted: 16-03-2022

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Impact of drying techniques on phytochemical stability in raw and blanched green peas

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DOI: <https://doi.org/10.33545/26174693.2022.v6.i1a.3066>

Abstract

Green peas (*Pisum sativum* L.) are a vital source of nutrients, including phytochemicals such as vitamins, carotenoids, polyphenols, and antioxidants, which contribute significantly to health promotion and the prevention of chronic diseases. Post-harvest drying is a critical preservation method, but it often impacts the stability and bioavailability of these phytochemicals. Blanching, a pre-treatment technique, is widely used to inactivate enzymes that degrade phytochemicals during drying. This review explores the effects of various drying methods, including hot air drying, freeze drying, and microwave drying, on the phytochemical stability of green peas, comparing the results for raw and blanched samples. The role of blanching in enhancing nutrient retention and the implications of these findings for nutritional quality and food preservation are also discussed.

Keywords: Green peas, phytochemical stability, drying techniques, blanching

Introduction

Green peas are a commonly consumed legume due to their high nutritional value, offering an abundance of bioactive compounds like flavonoids, phenolic acids, carotenoids, and vitamin C. These phytochemicals are sensitive to thermal and oxidative stresses, making their stability a key consideration in post-harvest preservation. Drying is one of the most effective methods for extending the shelf life of green peas by reducing moisture content to levels that inhibit microbial growth. However, the drying process can lead to significant nutrient loss. Blanching is often employed as a pre-treatment step before drying to inactivate enzymes such as peroxidase and polyphenol oxidase that degrade phytochemicals. This process also helps preserve color and texture while improving drying efficiency. However, the effectiveness of blanching and drying methods in retaining phytochemical content varies considerably. This review examines the effects of drying techniques on the phytochemical stability of green peas and evaluates the role of blanching in enhancing nutrient retention.

Objective

The objective of this paper is to evaluate the impact of different drying techniques on the phytochemical stability of green peas, both raw and pre-treated through blanching, to understand how these processes influence the retention of essential nutrients and bioactive compounds. Additionally, the study aims to explore the role of blanching as a pre-treatment in enhancing nutrient preservation during drying, providing insights into optimizing post-harvest processing methods to maintain the nutritional quality and health benefits of green peas.

Phytochemical Stability and Drying Techniques

The phytochemical profile of green peas includes vitamin C, carotenoids, polyphenols, and antioxidants, which contribute to their health benefits. However, these compounds are highly susceptible to degradation during drying. Hot air drying, one of the most commonly used methods, often results in significant losses due to prolonged exposure to high temperatures. Studies have shown that hot air drying can reduce antioxidant activity and polyphenol content by up to 50%, primarily due to thermal degradation ^[1]. Freeze drying, on the other hand, is considered a superior method for retaining heat-sensitive phytochemicals. This

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technique involves sublimation of frozen water under vacuum conditions, minimizing the exposure of nutrients to heat. Research indicates that freeze drying preserves up to 90% of vitamin C and 85% of polyphenols in green peas ^[2]. However, the high cost and longer processing time of freeze drying limit its application to industrial and high-value settings.

Microwave drying offers a promising alternative by using electromagnetic waves to generate heat and remove moisture rapidly. This technique minimizes nutrient loss by reducing drying time and oxidative exposure. Studies have reported that microwave drying retains 80–85% of carotenoids and polyphenols in green peas ^[3]. However, uneven heating can sometimes affect the uniformity of nutrient retention. Sun drying, although energy-efficient and widely used in traditional settings, results in significant nutrient losses due to prolonged drying times and exposure to UV radiation ^[4].

Role of Blanching in Enhancing Nutrient Retention

Blanching improves phytochemical stability during drying by inactivating enzymes that catalyze nutrient degradation. Water blanching, the most traditional method, often leads to leaching of water-soluble nutrients such as vitamin C. Steam blanching, which avoids direct contact with water, retains a higher proportion of phytochemicals, particularly carotenoids and polyphenols ^[3]. Microwave blanching has emerged as the most effective technique, preserving nutrients by minimizing leaching and reducing processing time. Blanching also enhances the drying process by improving moisture diffusion. Pre-treated green peas exhibit faster drying rates and better retention of color and texture. While blanching can slightly reduce the initial concentration of some nutrients, the benefits of enhanced phytochemical stability during drying outweigh these losses. The combination of blanching and advanced drying techniques, such as freeze drying or microwave drying, offers a robust strategy for preserving the nutritional quality of green peas.

Discussion

The impact of drying techniques on the phytochemical stability of green peas varies significantly depending on the method used. Freeze drying consistently outperforms other methods in retaining phytochemicals due to its low-temperature, low-pressure approach, which minimizes oxidative and thermal damage ^[2]. However, its high operational cost and time requirements make it less feasible for widespread use. Microwave drying provides a practical alternative with good nutrient retention and shorter drying times, although it requires specialized equipment ^[3]. Hot air drying, while cost-effective and accessible, results in considerable nutrient degradation, particularly for heat-sensitive compounds like vitamin C and polyphenols ^[1]. Sun drying, although energy-efficient, is the least effective in preserving phytochemical stability due to prolonged exposure to environmental factors ^[4].

Blanching significantly influences the effectiveness of these drying techniques. The use of steam or microwave blanching before drying improves nutrient retention by inactivating enzymes and reducing nutrient losses during the drying process ^[3]. These methods also enhance the sensory qualities of dried green peas, such as color and texture, making them more appealing to consumers. The findings of this review align with existing literature, reinforcing the

importance of combining pre-treatment techniques with advanced drying methods to maximize nutrient retention.

The practical implications of these findings are substantial, particularly in the context of addressing post-harvest losses and improving the nutritional quality of preserved foods. Blanching and drying methods that prioritize phytochemical stability can enhance the health benefits of green peas, contributing to better dietary outcomes. Future research should focus on optimizing the parameters of blanching and drying processes to improve their feasibility and scalability for different settings. Additionally, the sensory and economic aspects of these methods should be evaluated to ensure their practical adoption.

Conclusion

Drying techniques play a critical role in determining the phytochemical stability of green peas, with freeze drying and microwave drying emerging as the most effective methods. Blanching as a pre-treatment significantly enhances nutrient retention, particularly when using steam or microwave techniques ^[3]. These findings highlight the potential of integrating blanching with advanced drying methods to preserve the nutritional and sensory qualities of green peas.

While the cost and operational complexity of some techniques may limit their widespread adoption, their benefits in terms of nutrient retention and shelf-life extension make them valuable tools in food preservation. Future efforts should aim to make these technologies more accessible and affordable, particularly in resource-constrained settings. By prioritizing phytochemical stability, these innovations can contribute to sustainable food systems and improved dietary health.

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