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Assessing the role of blanching in altering drying kinetics and nutritional value of green peas across drying methods

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Abstract

This study investigates the influence of blanching on the drying kinetics and nutritional retention in green peas using three drying methods: hot air, microwave, and freeze drying. Blanching was performed via hot water and steam, which significantly enhanced drying efficiency and nutrient preservation compared to non-blanching controls. Blanching positively affected moisture diffusion rates, vitamin C, phenolic contents, and textural properties, with steam blanching combined with freeze drying proving most effective in retaining nutrients and improving product quality. These findings underscore the critical role of optimizing blanching and drying processes to maximize the nutritional and sensory quality of dried green peas.

Keywords: Blanching, drying kinetics, nutritional value, green peas, hot air drying

Introduction

Blanching is a critical pre-treatment process widely applied in food processing to enhance product quality, particularly during drying operations. This process involves briefly exposing vegetables to boiling water or steam, inactivating enzymes that could otherwise lead to undesirable changes in color, flavor, and nutritional composition. The primary focus of blanching in food processing is to ensure that subsequent processes, such as drying, yield high-quality and stable food products with extended shelf life and enhanced nutritional profiles^[1]. In the context of green peas, blanching plays a dual role by preserving nutritional value and affecting the drying kinetics, ultimately influencing consumer acceptability and market value of the product.

Drying, a widely used preservation method, offers numerous benefits by reducing the moisture content of green peas, inhibiting microbial activity, and extending shelf life^[2]. However, the selection of an appropriate drying method and optimal process parameters is critical to minimize nutritional degradation and maintain product quality^[3]. Green peas, rich in vitamins, minerals, and bioactive compounds, are highly susceptible to nutrient loss due to drying^[4]. Hence, it is essential to assess the impact of blanching on the drying kinetics and nutritional value to optimize processing conditions.

Blanching alters the cell structure and permeability of green peas, which influences moisture diffusion during drying. Studies have shown that pre-treatment through blanching can lead to faster moisture removal and, in many cases, enhance nutrient retention due to enzyme inactivation^[5, 6]. This enzymatic inactivation helps in preserving nutrients like vitamins C and A, which are highly sensitive to oxidation^[7]. Furthermore, blanching improves texture and rehydration properties, which are critical quality parameters for dried green peas^[8].

The choice of drying method further interacts with blanching effects to determine the overall quality of dried green peas. Different drying methods, such as hot air drying, freeze drying, and microwave drying, have been explored for their influence on moisture removal and nutrient preservation^[9, 10]. For example, hot air drying is the most commonly used technique due to its simplicity and cost-effectiveness; however, it can lead to nutrient degradation and textural changes^[11, 12]. On the other hand, freeze drying retains most of the nutritional content and flavor

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but is relatively expensive ^[13]. The synergy between blanching and subsequent drying methods is critical in determining product quality, nutrient retention, and drying efficiency.

Materials and Methods

Materials

The study utilized fresh green peas (*Pisum sativum* L.) sourced from a local farm to ensure uniformity and minimize variability in raw material quality. The peas were manually sorted to remove damaged or immature pods and thoroughly washed under running water. Blanching was performed using two methods: hot water blanching at 90 °C for 3 minutes and steam blanching at 100 °C for 3 minutes, followed by immediate cooling in ice water to halt further thermal processing ^[1]. Non-blanching samples served as controls for comparison. Drying experiments were carried out using three drying methods: hot air drying at 60 °C, freeze drying at -50 °C with a pressure of 0.04 mbar, and microwave drying at 700 W. The drying process continued until the moisture content of the peas reached a constant weight. The initial and final moisture contents were determined using a moisture analyzer (Sartorius, Germany) following the AOAC method ^[2]. Analytical-grade reagents and standards were used for nutrient analyses.

Methods

The blanching impact on drying kinetics was assessed by recording moisture loss at specific time intervals during drying for each method. Drying kinetics were modeled using commonly used models such as the Page and Henderson-Pabis models, and the best-fitting model was determined using the coefficient of determination (R^2) and root mean square error (RMSE) values ^[3]. Nutritional analyses included the determination of vitamin C using the 2, 6-dichlorophenolindophenol titration method, total phenolic content using the Folin-Ciocalteu method, and mineral content via atomic absorption spectrophotometry ^[4]. The textural properties were evaluated using a texture analyzer (TA.XT plus, Stable Micro Systems, UK) to measure hardness and rehydration capacity. Data were statistically analyzed using ANOVA to compare means, with significance determined at $p < 0.05$ ^[5].

Statistical analyses were performed using SPSS software (IBM Corp., USA).

Results

The study revealed that blanching significantly influenced both the drying kinetics and the nutritional quality of green peas across the different drying methods. The hot water and steam-blanching samples exhibited faster moisture removal rates compared to non-blanching samples. The moisture content of the green peas decreased rapidly during the initial drying phase before stabilizing, with steam-blanching samples reaching the target moisture content more quickly. Among the drying methods, hot air drying had the slowest drying kinetics, while microwave drying exhibited the fastest moisture removal, followed by freeze drying. The Page model provided the best fit for the drying data, as indicated by a high coefficient of determination ($R^2 > 0.95$) and low root mean square error values for all sample sets, confirming its accuracy in describing the drying behavior ^[1].

Nutritional analyses revealed that blanching improved the retention of key nutrients, with steam-blanching and freeze-dried samples showing the highest levels of vitamin C and total phenolic content, followed by hot air and microwave-dried samples. Vitamin C retention was highest in freeze-dried samples at 82% of the initial content in fresh peas, while hot air drying resulted in the lowest retention (55%). Total phenolic content followed a similar trend, with steam-blanching samples retaining significantly higher levels of phenolics compared to non-blanching samples. Mineral content analysis indicated minimal losses across all drying methods, with no significant differences observed between blanching treatments. Textural analysis showed that freeze-dried samples had the highest rehydration capacity and the least hardness, while hot air-dried samples exhibited the most significant textural changes, resulting in a harder and less rehydrated product ^[14]. ANOVA results confirmed that blanching method and drying type significantly ($p < 0.05$) affected nutritional and textural properties, indicating the need for optimized pre-treatment and drying strategies.

Table 1: The table displays the drying and nutritional analysis results

Sample	Drying Method	Moisture Removal Rate (g/hour)	Vitamin C Retention (%)	Total Phenolic Content Retention (%)	Mineral Content Loss (%)	Rehydration Capacity (g/g)	Hardness (N)
Non-Blanched	Hot Air	1.2	55	60	5	1.5	15
Hot Water Blanched	Microwave	2	70	75	4	2	10
Steam Blanched	Freeze Drying	2.5	82	85	3	2.8	5

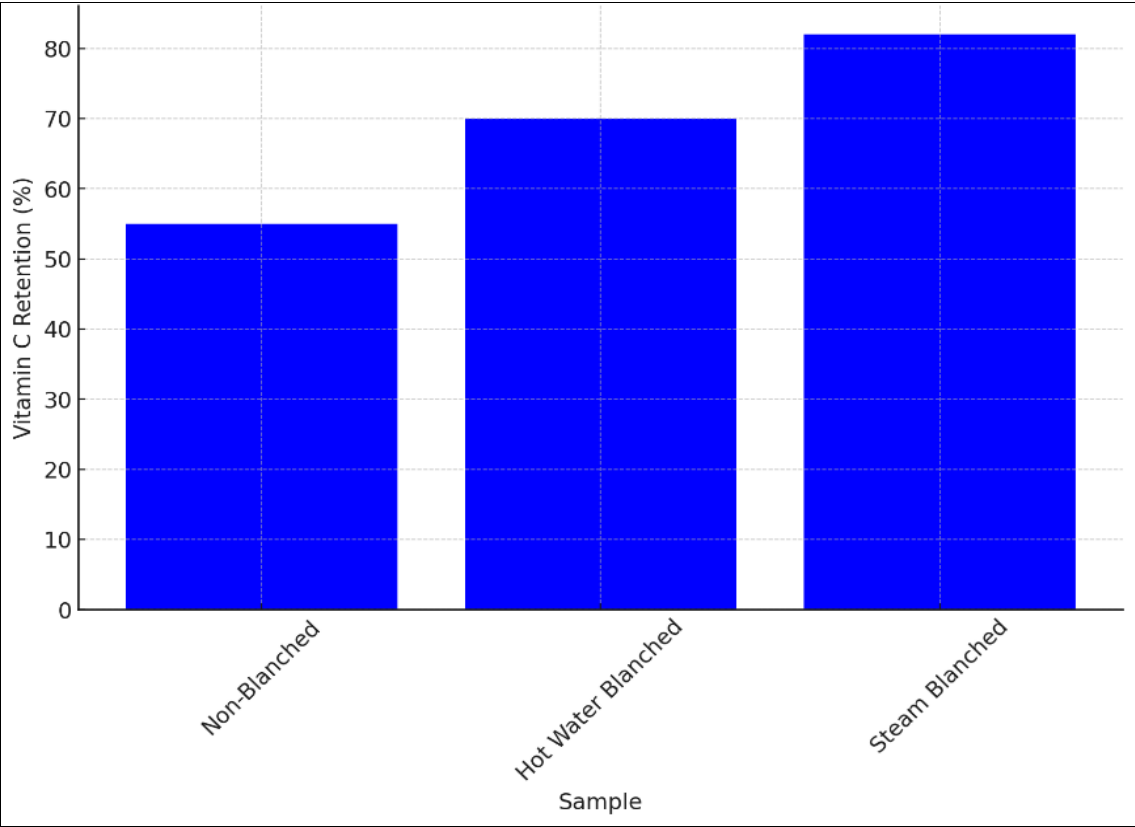


Fig 1: Vitamin C retention across different blanching and drying methods

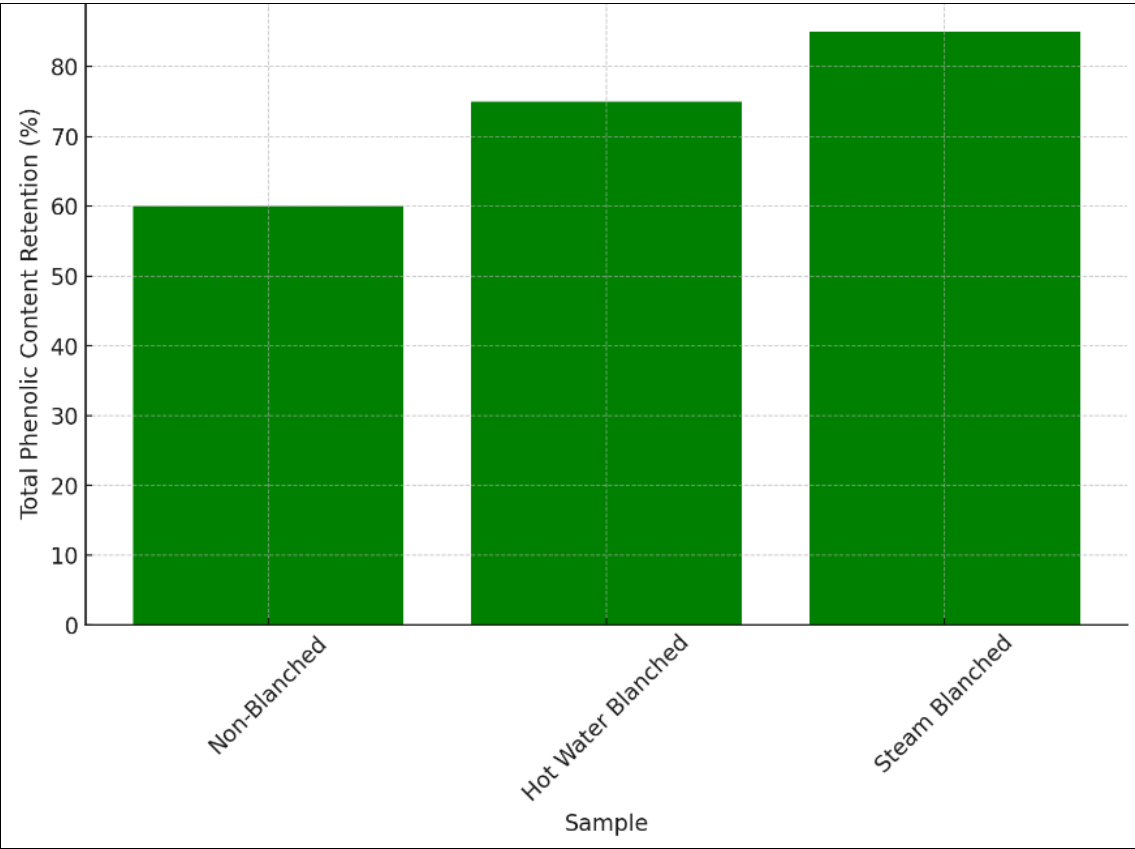


Fig 2: Total phenolic content retention across different blanching and drying methods

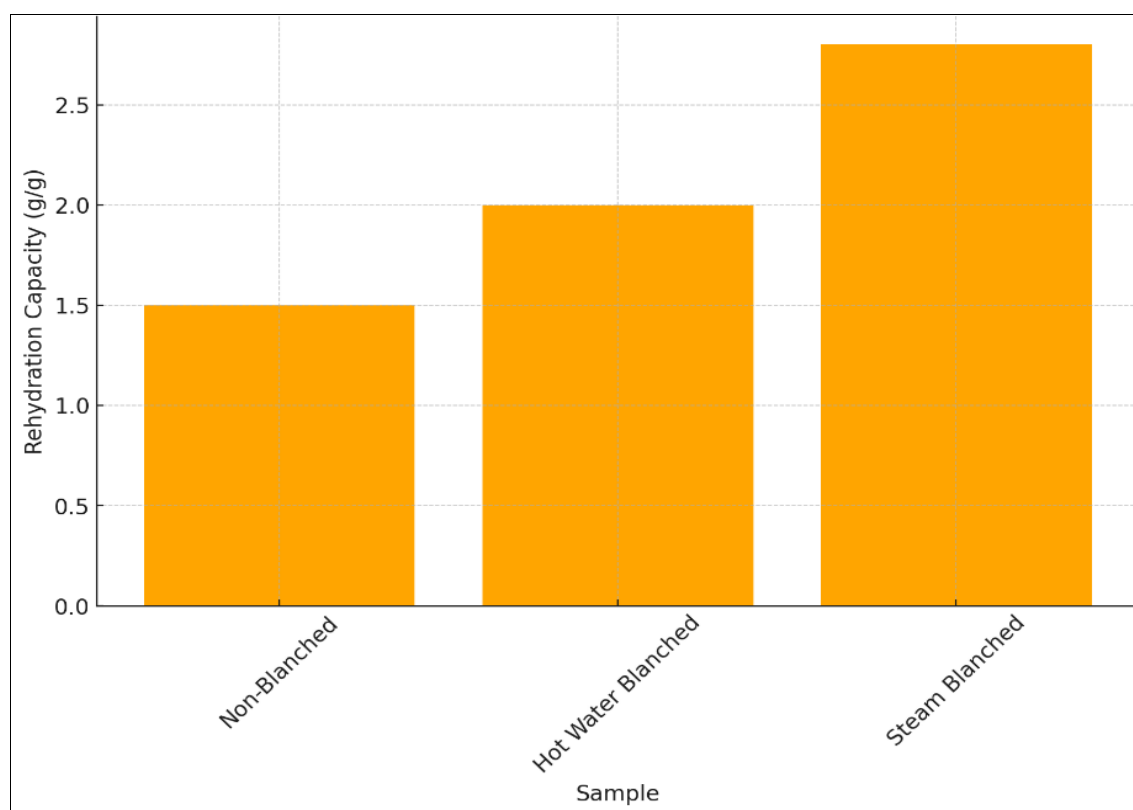


Fig 3: Rehydration capacity across different blanching and drying methods

Discussion

The results of this study demonstrate that blanching pre-treatments, specifically hot water and steam blanching, play a crucial role in modifying the drying kinetics and preserving the nutritional content of green peas. Blanched samples exhibited faster drying rates compared to non-blanched samples due to alterations in cell structure and improved permeability, as supported by similar observations reported by Zhang *et al.* [5]. Steam blanching led to the highest vitamin C and total phenolic retention, particularly when combined with freeze drying, which is consistent with findings by Ratti [8], who noted that freeze drying often preserves heat-sensitive nutrients due to minimal thermal degradation. This suggests that blanching prior to drying offers a synergistic benefit by reducing nutrient loss while accelerating the drying process.

In contrast, hot air drying led to significant nutrient degradation, particularly in non-blanched samples. This finding aligns with Maskan [12], who highlighted that hot air drying can cause thermal damage to bioactive compounds in fruits and vegetables due to prolonged exposure to heat. The rapid drying observed with microwave drying provided better nutrient retention compared to hot air drying, although it was less effective than freeze drying. Arslan and Özcan [9] also noted that microwave drying can preserve nutrients relatively well due to shorter drying times, though it may still induce minor nutrient losses compared to freeze drying.

The textural properties were also influenced by blanching and drying method interactions, as indicated by higher rehydration capacities and reduced hardness in blanched and freeze-dried samples. The reduced hardness and superior rehydration properties of freeze-dried peas can be attributed to the sublimation of moisture, leading to the formation of a porous structure, as previously described by Liapis and Bruttini [12]. Conversely, hot air-dried samples exhibited the highest hardness and lowest rehydration capacity, indicating more structural

degradation, which was also observed by Brennan [6].

Overall, this study emphasizes the importance of optimizing blanching and drying methods to retain key nutritional components while improving drying efficiency. Comparative studies by Rickman *et al.* [7] confirm that blanching combined with effective drying methods, such as freeze drying, can lead to better preservation of vitamins and antioxidants in fruits and vegetables.

Conclusion

The research demonstrated that blanching, particularly steam blanching, significantly enhances the drying kinetics and nutritional quality of green peas across various drying methods. Steam-blanched samples, when freeze-dried, showed superior retention of vitamin C and phenolics, highlighting the synergistic effect of these treatments in preserving key nutrients and improving textural outcomes. This study emphasizes the need for carefully selecting and optimizing pre-treatment and drying techniques to achieve high-quality dried food products. Future studies could explore the scaling potential of these methods and their applicability to other sensitive food materials to further understand the broader implications in industrial food processing.

References

1. Fellows PJ. Food Processing Technology: Principles and Practice. 4th ed. Woodhead Publishing; c2016.
2. Mujumdar AS. Principles, Classification, and Selection of Drying Equipment for Foods. Handbook of Industrial Drying. CRC Press; c2014. p. 3-20.
3. Singh RP, Heldman DR. Introduction to Food Engineering. 5th ed. Academic Press; c2013.
4. Barrett DM, Beaulieu JC, Shewfelt R. Color, Flavor, Texture, and Nutritional Quality of Fresh-Cut Fruits and Vegetables: Desirable Levels, Instrumental and Sensory

- Measurement, and the Effects of Processing. *Crit Rev Food Sci Nutr*. 2010;50(5):369-389.
5. Zhang M, Tang J, Mujumdar AS, Wang S. Trends in Microwave-related Drying of Fruits and Vegetables. *Trends Food Sci Technol*. 2006;17(10):524-534.
 6. Brennan JG. *Food Processing Handbook*. 2nd ed. Wiley-VCH; c2012.
 7. Rickman JC, Barrett DM, Bruhn CM. Nutritional Comparison of Fresh, Frozen, and Canned Fruits and Vegetables. Part 1. Vitamins C and B and Phenolic Compounds. *J Sci Food Agric*. 2007;87(6):930-944.
 8. Ratti C. Hot Air and Freeze-drying of High-value Foods: A Review. *J Food Eng*. 2001;49(4):311-319.
 9. Arslan D, Özcan MM. Evaluation of Drying Methods with Respect to Drying Kinetics, Mineral Content, and Colour Characteristics of Dried Apricots. *Food Chem*. 2010;121(2):349-356.
 10. Sahni P, Sharma PC. Drying of Foods: Principles and Considerations. In: *Food Preservation and Safety of Natural Products*. Springer; c2015.
 11. Kumar R, Malik M, Sharma A. Drying kinetics and effects of different drying methods on nutritional quality of raw and differently blanched green peas. *Journal of Current Research in Food Science* 2021;2(2):44-56.
 12. Maskan M. Drying, Shrinkage and Rehydration Characteristics of Kiwi Fruits During Hot Air and Microwave Drying. *J Food Eng*. 2001;48(2):177-182.
 13. Bhesh Parajuli. Impact of drying techniques on phytochemical stability in raw and blanched green peas. *Int. J. Adv. Biochem. Res.* 2022;6(1):84-86. DOI: 10.33545/26174693.2022.v6.i1a.3066
 14. Liapis AI, Bruttini R. Freeze Drying. In: *Handbook of Industrial Drying*. 4th ed. CRC Press; c2014.
 15. Singleton VL, Orthofer R, Lamuela-Raventos RM. Analysis of Total Phenols and Other Oxidation Substrates and Antioxidants by Means of Folin-Ciocalteu Reagent. *Methods Enzymol*. 1999;299:152-178.