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Research Paper

The Effect of Cold Plasma with Argon Gas in Increasing the Shelf Life of Red Guava Fruit

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Extended Abstract

Introduction

The demand for longer shelf life and improved quality of agricultural and food products has increased globally due to rising standards in health, organic food consumption, and international trade. To meet these demands, new preservation technologies are essential. Cold plasma technology, a non-thermal process, has gained attention in food industries for its potential to extend the shelf life of fruits by effectively deactivating microorganisms and enzymes responsible for spoilage. This study focuses on the impact of cold plasma with argon gas on the shelf life of red guava (*Psidium guajava* L.) and its ability to improve fruit quality.

Methods

Fresh red guava fruits were sourced from the Sistan and Baluchestan province, Iran, with a uniform size and microbial contamination level. The fruits were inoculated with *Aspergillus niger* and subjected to various cold plasma treatments with argon gas. The

treatments were applied for different durations (150, 300, 450, 600, 750, 900, 1050, and 1200 seconds). The cold plasma treatment was conducted under controlled conditions (electrode spacing of 920 mm, frequency of 8 kW, and power of 8 W). Throughout the study, physical, chemical, and microbiological analyses were performed on the fruits at regular intervals (day 1, 14, and 28) to assess the effects of the treatments.

Results and Discussion

The cold plasma treatments significantly reduced the mold count of guava fruits, as shown by the reduction in *Aspergillus niger* growth. The results indicated that treatments lasting longer than 450 seconds were the most effective in minimizing microbial contamination. Among all treatments, the 1200-second plasma exposure (Pat8) demonstrated the highest reduction in mold count. In terms of fruit texture, plasma treatment helped preserve firmness compared to untreated guava fruits, with the firmness of plasma-treated fruits improving notably. Additionally, the pH of treated fruits remained more stable compared to the control, suggesting less acidification. The antioxidant activity, measured using the DPPH method, was also better preserved in treated fruits, with longer plasma treatment durations enhancing the antioxidant properties. Cold plasma has proven to be an effective, non-thermal method for preserving the shelf life and improving the quality of red guava. By reducing microbial growth, including *Aspergillus niger*, and inhibiting the deterioration of fruit texture and pH, cold plasma offers a promising alternative to traditional thermal preservation methods. The longer plasma exposure times (750–1200 seconds) produced the best results in reducing microbial counts, preserving fruit firmness, and maintaining antioxidant activity, all of which are critical for improving fruit longevity. The non-thermal nature of cold plasma ensures that the sensory attributes, such as flavor and texture, are preserved, unlike some other preservation methods that may lead to undesirable changes in taste and appearance. Furthermore, this method provides an environmentally friendly solution with low energy consumption compared to traditional methods like chemical treatments or refrigeration.

Conclusion

Cold plasma with argon gas is a highly effective technology for extending the shelf life of red guava while maintaining or enhancing its physical, chemical, and sensory qualities. The research highlights the significant potential of cold plasma as a green, non-thermal method for food preservation, capable of meeting the increasing demand for longer-lasting, high-quality agricultural products. The results suggest that cold plasma treatment can serve as an alternative preservation method in the post-harvest management of fruits, especially for international markets where long shelf life and high quality are paramount. However, further research is needed to evaluate the economic viability of cold plasma technology and its long-term effects in large-scale industrial applications.

Keywords: Cold Plasma, Guava, Microorganisms, Shelf life, Argon Gas

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