

Sustainable Preservation Solution for Fruit and Vegetables: Edible Films and Partial Coating Technologies

モハマド ハマヨーン ワーダック

<https://hdl.handle.net/2324/7396292>

出版情報 : Kyushu University, 2025, 博士（農学）, 課程博士
バージョン :
権利関係 :



Name : モハマド ハマヨーン ワーダック
(MOHAMMAD HAMAYOON WARDAK)

Title : Sustainable Preservation Solution for Fruit and Vegetables: Edible Films
and Partial Coating Technologies
(持続可能な青果物保存技術としての可食フィルムと部分コーティング)

Category : KOU

Thesis Summary

This dissertation focuses on the developments and application of innovative edible films and coating, with particular attention to a groundbreaking partial coating technique to maintain the postharvest quality and enhance shelf-life of fresh fruits. As a global demand escalates for sustainable and environmentally friendly alternative to traditional plastic packaging, significant research has focused on natural biopolymer-based coating. These innovative materials not only function as protective barriers but also provides bioactive properties such as antimicrobial and antioxidant properties.

The first study introduces a novel partial coating approach that regulates that gas exchange and moisture transfer by covering the main route of transpiration in perishable fruits. A composite film formulation – comprising citric acid-crosslinked starch reinforced with cellulose nanofiber (CNF) – was applied to tomato fruits. This technique addresses critical limitation of conventional full coating, such as prolong drying time and safety concerns of consumers, while effectively reduced respiration and moisture transpiration. Incorporating CNF enhanced the film's mechanical, thermal and barrier performance. Storage trials revealed no significant differences between the partial and full coatings, in terms of weight loss, firmness and color parameter, though both coating methods were outperformed uncoated fruits.

The second study explores the optimization of an edible coating composed of sodium alginate and kiwifruit seed essential oil (KSO) to improve the postharvest quality of persimmon fruits. The formulation was

optimized to achieve enhanced film barrier, mechanical, thermal, structural integrity, and bioactive retention. The partial coating strategy was designed to allow selective coverage, maintaining physiological balance and extend the shelf life of persimmon. This work underscores the potential of the innovative approach of partial coating with SA and KSO coating materials to preserve the quality of persimmon fruits during storage and suggest that it can extend the shelf-life and marketability of this product.

Building on these findings, the third study evaluate how drying conditions influence the structural and functional characteristics of sodium alginate films enriched with kiwifruit seed essential oil (KSO). This research demonstrates that drying temperature plays a vital role in determining film morphology and performance, with moderate temperatures promoting uniform oil dispersion and film integrity while higher drying temperature causes phase separation and structural discontinuity. The study provides valuable insights for optimizing manufacturing protocols to ensure consistent quality in biopolymer-based packaging, reinforcing the potential of sustainable food preservation technologies.

Collectively, these studies demonstrate a comprehensive approach to edible coating development—integrating innovation formulation, process optimization, and targeted application. The research underscores the advantages of combining natural biopolymers such as starch, sodium alginate, and cellulose nanofibers with bioactive plant-based oils to create coatings that are not only safe and eco-friendly but also effective in prolonging shelf life of fruits. The novel partial coating technique introduced in this work offers a promising alternative to conventional methods.