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Effect of *Kelulut* Honey Nanoparticles Coating on the Changes of Respiration Rate, Ascorbic Acid, and Total Phenolic Content of Papaya (*Carica papaya* L.) during Cold Storage

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Abstract: This study evaluated the respiration rate of coated and uncoated (control) papayas (*Carica papaya* L.) with 15% of *Kelulut* honey (KH) nanoparticles (Nps) coating solution during cold storage at 12 ± 1 °C for 21 days. The respiration rate of the papayas significantly changed during storage, with an increase in CO_2 and a decrease in O_2 and C_2H_4, while the ascorbic acid and total phenolic content was maintained. The changes in respiration rate were rather slower for coated papayas when compared to control ones. A kinetic model was established from the experimental data to describe the changes of O_2, CO_2, and C_2H_4 production in papayas throughout the storage period. All O_2, CO_2, and C_2H_4 were experimentally retrieved from a closed system method and then represented by the Peleg model. The outcomes indicated the Peleg constant K_1 and K_2, which were gained from linear regression analysis and coefficients of determination (R^2), seemed to fit well with the experimental data, whereby the R^2 values exceeded 0.85 for both coated and control papayas. The model confirmed both the capability and predictability aspects of the respiration rate displayed by papayas coated with KH Nps throughout the cold storage period. This is supported by the differences in the stomatal aperture of coated and control papaya shown by microstructural images.

Keywords: kinetic model; Peleg constant; papaya; respiration rate; nanoparticles coating; shelf life

1. Introduction

Papaya is a tropical climacteric fruit with high respiration rates and ethylene (C_2H_4) production during ripening. The fruit is rich in vitamins, minerals, and dietary antioxidants [1]. Nevertheless, it has a short life span due to its climacteric respiration pattern. Papaya of colour indices 2 and 3 can last between five and seven days at ambient temperature, while those with colour indices 4 and 5 can maintain their quality for only two to three days [2]. The short life span enhances the rate of natural deterioration, such as physicochemical damages that eventually increase its susceptibility to diseases and infection [3]. This results in post-harvest loss, a deficit in production yield, as well as a limitation to long-distance export destinations.

The two post-harvest handling strategies, namely modified atmosphere packaging (MAP) and controlled atmosphere (CA), can effectively control the quality of fresh produce by modifying the gas exchange of the fresh produce and its nearby atmosphere [4–6]. Edible