Abstract

Many farmers in Ehime Prefecture, Japan have unfortunately faced with some difficulties of physiological disorder for citrus fruits, particularly in 'Kiyomi' Tangor fruits, which have the serious problem of rind injury occurred as brown spotting or brown-pitted area. The objective of this research is to investigate the cause of rind injury and physiological properties of 'Kiyomi' Tangor and apply Modified Atmosphere Packaging (MAP) with perforation to solve this rind injury. In year 2002, storing 'Kiyomi' Tangor fruits in four treatments: LDPE film with small, medium and large perforation numbers, and individual package without perforation was conducted at 10°C in order to find out the cause of rind injury occurrence. The small, medium and large number of perforation was considered as low, medium and high gas transmission rate, respectively. From the experimental result, both rind injury and weight loss was greatly detected in large perforation, followed by medium, low perforation and individual package without perforation, respectively. Then, we further conducted the experiment to observe the effect of weight loss on rind injury of 'Kiyomi' Tangor fruits by keeping in the ambient storage room without package in year 2003. The data shown that the higher water loss, the higher occurrence of rind injury is found. It is strongly believed that the main cause of this rind injury results from weight loss due to the produce transpiration. In order to alleviate rind injury occurrence, MAP with perforation has been introduced because of various benefits, such as preventing water loss, preventing deficient oxygen and excessive carbon dioxide, avoiding the inside-package condensation. Moreover, the mathematical model as simultaneously ordinary differential equation by considering oxygen, carbon dioxide, nitrogen, and water vapor for simulating gas exchange in MAP with perforation has been created. This model also can anticipate what equilibrium gas composition will be and how long it is required to reach this condition. The Runge-Kutta fourth-order method has been utilized for solving this differential equation. To utilize the model, it was firstly desired to identify gas permeability coefficients both through polymeric film (LDPE) and perforation. Both values at 5, 15, and 25°C were experimentally found out. Secondly, it is needed to know the respiration and transpiration rate of used produce. Definitely, we have decided to employ 'Kiyomi' Tangor fruit as the research material. From the experimental data, the respiration and transpiration model were established. For validating the proposed model, lots of experiments have been conducted by varying package surface area, perforation number and amount of samples to compare the empirical data with calculated data.