Title	Development of a mathematical model for simulating gas and water vapor exchanges in modified atmosphere packaging with macroscopic perforations
Author	Nutakorn Techavises and Yoshio Hikida
Citation	Journal of Food Engineering, Volume 85, Issue 1, March 2008, Pages 94-104
Keywords	MAP; Perforation; Model; Permeability; Transmission rate; Fresh produce

Abstract

A mathematical model based on Fick's law for predicting O_2, CO_2, N_2, and water vapor exchanges in modified atmosphere packaging (MAP) films with macroperforations was developed. The effective permeability of a perforation was measured for temperatures from 5 to 25 °C, perforation diameters from 2 to 15 mm and film thicknesses of 0.012 and 0.025 mm. The temperature and film thickness had no significant effect on the effective permeability ($P > 0.05$). For most conditions, the effective permeability did not differ between gas types (O_2, CO_2, N_2, and water vapor). An empirical equation of the effective permeability of a macroperforation in a thin film as a function of perforation diameter was developed. The transmission rate of LDPE film was determined for temperatures between 5 and 25 °C. The effects of temperature on gas and water vapor transmission rates followed the Arrhenius model. The use of the proposed MAP model coupled with an effective permeability model was found to yield a good prediction of gas concentration and RH when compared to experimental results for MAP of 'Kiyomi' fruit.