An efficient optimization methodology of respiration rate parameters coupled with transport properties in mass balances to describe modified atmosphere packaging systems

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Abstract

In this study, we aimed to describe a modern, efficient, and reproducible methodology to optimize respiration rate parameters coupled with transport properties in mass balances describing Modified atmosphere packaging (MAP) systems. We considered mass balances for three different respiration rate j film (exponential, competitive and uncompetitive Michaelis-Menten kinetics) coupled with transport properties for two different packaging films. Experiments were conducted to validate the methodology using grapes placed in a polypropylene container opened on the top and sealed with packaging films. The methodology relies on a numerical optimization procedure called the Trust-Region-Reflective algorithm. We determined the predictive capability of models using goodness-of-fit criteria and assessed parameter uncertainty through standard errors. We also calculated the first-order optimality measure and the relative change in the sum of squares to verify the convergence of the implemented algorithm. Results showed that the respiration rate parameters obtained with this methodology for the exponential model provided a better fit than for the other two models. The fitting for the kinetic models is not very suitable since we found that the normalized standard errors were rather high. In conclusion, the methodology is robust, and we expect that it serves as a tool for assessing MAP technology design.

Palabras clave

Palabras clave de autor: Model parameter estimation; Trust-Region-Reflective algorithm; respiration rate; mass balance; MAP systems
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