Abstract

Knowledge and modeling of respiration rates at different gas atmospheres is required to determine the gas compositions in MAP. The application of superatmospheric oxygen concentrations is a relatively new research area in MAP and CA storage and little research has been done on respiration rates under these conditions. The objective of this paper is to present a general methodology to measure and model respiration of fresh fruit and vegetables at superatmospheric oxygen and carbon dioxide concentrations. The methodology was applied to 'Elsanta' strawberries and fresh-cut butterhead lettuce. 'Elsanta' strawberries and fresh-cut butterhead lettuce were placed in glass jars through which humidified gas mixtures, ranging from 0 to 100% oxygen in combination with 0, 10 or 20% CO_2, were flushed. The jars were placed in cool rooms at three different temperatures. Respiration rates were determined by measuring oxygen consumption and carbon dioxide production rates using a micro-GC. In order to define effects of different variables (gas mixture, temperature, batch of produce, position of jars) the respiration data were first subjected to an analysis of variance (ANOVA). The respiration rates were then modeled using Michaelis-Menten type kinetics. The temperature dependencies of the model parameters were modeled with the Arrhenius equation. To include effects of carbon dioxide and superatmospheric oxygen concentrations, inhibition terms were inserted in the model. Four different types of inhibition kinetics were examined: competitive, uncompetitive, non-competitive and mixed inhibition. Models comparison was based on the adjusted R^2 and the RMSE (Root Mean Squared Error). For both products the respiration rates decreased with decreasing temperatures and oxygen concentrations (below 20 kPa) and increasing carbon dioxide concentrations. However, a CO_2 concentration of 20 kPa again caused an increase in respiration rate of fresh-cut butterhead lettuce in comparison to 10 kPa CO_2. The effect of superatmospheric oxygen concentrations was dependent on the produce. For strawberries, the respiration rate at high oxygen levels was comparable to the respiration at 20 kPa O_2. On the contrary, respiration rates of fresh-cut butterhead lettuce were significantly reduced by superatmospheric oxygen concentrations. Overall models with a highly satisfying predictive power were constructed for both strawberries and fresh-cut butterhead lettuce.