MICHIGAN STATE
UNIVERSITY

Multistate Research Project S-294
Postharvest Quality and Safety in Fresh-cut Vegetables and Fruits

2007-2008 Activities Report

Institution: Michigan State University

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Introduction:
The aim of this work was to characterize the respiratory behavior of fresh-cut pear under modified atmosphere at different temperatures to provide information useful to the development of mathematical models for the design of appropriate packages.

Activities:
Objective 2. Develop new strategies to maintain fresh-cut product quality

Maintenance of flavor, texture, color, nutrients and safety assurance during processing and throughout the distribution chain are major challenges facing the fresh-cut fruit industry. Improving knowledge of cut fruit physiology and biochemistry will help drive innovative treatments and aid in the development of packaging technologies to reduce retail losses and improve the overall marketability and success of these products. The aim of this work was to characterize the respiratory behavior of fresh-cut pear under modified atmosphere at different temperatures to provide information useful to the development of appropriate packages.

Respiration rates were measured in 'Rocha' pear (*Pyrus communis*) slices, using a permeable membrane respirometry system. Rates of O_2 uptake and CO_2 production and respiratory quotient (RQ) were calculated once steady-state O_2 and CO_2 partial pressures were achieved in the packages using partial pressure gradient for each gas, film permeability and fruit weight[1,2]. Twelve different combinations of film thickness, film area, and fruit mass were used and four different temperatures imposed (0 ºC, 5 ºC, 10 ºC and 15 ºC) to achieve twelve target O_2 levels at each temperature. Three replicates per target O_2 level were established.

Packages with fresh-cut pear reached steady-state after 5 days (15 ºC), 8 days (10 ºC) and 10 days (5 ºC and 0 ºC). O_2 uptake increased with temperature and with $pO_{2\ pkg}$ in a manner consistent with Michaelis-Menten saturation kinetics (Fig. 1). The maximal rate of O_2 uptake ($R_{O2}^{max,T}$) and the O_2 partial pressure in the package at 50% of $R_{O2}^{max,T}$ ($K_{1/2}^{T}$) at 0 ºC, 5 ºC, 10 ºC and 15 ºC were estimated. $R_{O2}^{max,T}$ (mmol kg^{-1} h^{-1}) was modeled as an exponential function of T (Kelvin)[2,3]: $R_{O2}^{max,T}{}_{pear} = 1.42\times10^{-19}\times e^{0,151T}$ (R^2=0.992). The increase in the maximal rate of O_2 uptake with temperature was equivalent to a Q_{10} of approximately 4.4. $K_{1/2}^{T}$ varied with temperature between 0 ºC and 15 ºC; the best fit was obtained with a polynomial equation. The activation energy (E_a) for respiration was approximately 98 kJ/mole[2,3].

These data provide a basis to predict package permeability and steady-state $pO_{2\ pkg}$ to prevent anaerobic conditions and maximize shelf-life of fresh-cut pear.

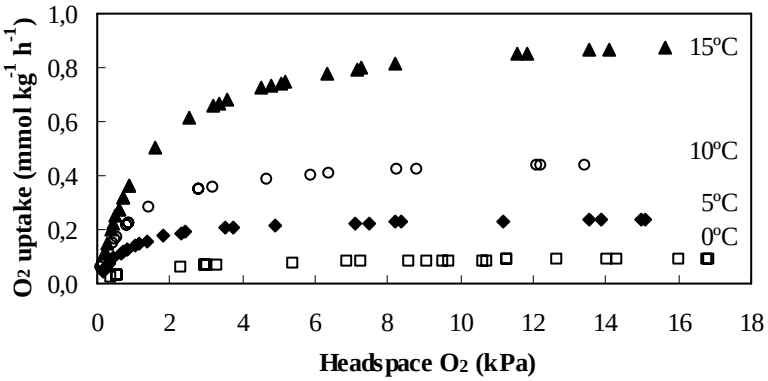

Figure 1. *Effect of steady-state O_2 partial pressure and storage temperature on the calculated rate of O_2 uptake for fresh-cut 'Rocha' pear:* $R_{O2} = [(R_{O2}^{max,T} * pi,O_2) / (K_{1/2}^{T} + pi,O_2)]$

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References

[1]Beaudry, R.M., Cameron, A.C., Shirazi, A. & Dostal-Lange, D.L. (1992). *J. Amer. Soc. Hort. Sci.* 117(3): 436-441.

[2]Lakakul, R., Beaudry, R.M. & Hernandez, R.J. 1999. *J Food Sci*. 64 (1): 105-110.

[3]Cameron, A.C., Beaudry, R.M., Banks, N.H., Yelanich, M.V. (1994). *J. Amer. Soc. Hort. Sci.* 119(3): 534-539.

Projects for 2008:

- Evaluation of aroma profiles and gene expression of sliced pear and cubed melon as a function of oxygen.
- Evaluation of gene expression of chilled and heat-treated tomato fruit
- Transformation of yeast and Arabidopsis to generate aroma esters for characterizing genes in the aroma biosynthesis pathways.

Publications:

Sozzi, Gabriel O. and R.M. Beaudry. 2007. Current perspectives on the use of 1-methylcyclopropene in tree fruit crops: an international survey. Stewart Postharvest Review 3(2):1-16.

Nanthachai, N., Kosittrakun, M., and R. Beaudry. 2007. Absorption of 1-MCP by fresh produce. Postharvest Biol. Technol.43:291-297.

Gunterus, A., Roze, L.V., Beaudry, R. and J.E. Linz. 2007. Ethylene inhibits aflatoxin biosynthesis in *Aspergillus parasiticus* grown on peanuts. Food Micro. 24:658-663.

Roze, L.M, Beaudry, R.M., Arthur, A.E., Calvo, A.M., and J.E. Linz. 2007. Aspergillus volatiles regulate aflatoxin synthesis and asexual sporulation in *Aspergillus parasiticus.* Appl. Env. Micro. 73: 7268-7276.

Fan, L., Song, J., Beaudry, R.M., and P.D. Hildebrand. 2006. Effect of hexanal vapor on spore viability of *Penicillium expansum*, lesion development on whole apples and fruit volatile biosynthesis J. Food Sci. 71(3):105–109

Sugimoto N., S. Park, S. van Nocker, and R. Beaudry. 2007. Gene expression associated with apple aroma biosynthesis. Acta Horticulturae (in press).