Institution: Produce Quality and Safety Laboratory, Beltsville Agricultural Research Center, Agricultural Research Service, United States Department of Agriculture, Beltsville, MD 20705.

Participants: William Conway (Conwayw@ba.ars.usda.gov)
Kenneth C. Gross (Grossk@ba.ars.usda.gov)
Yaguang Luo (Luoy@ba.ars.usda.gov)
James L. McEvoy (McEvoyj@ba.ars.usda.gov)
Robert A. Saftner (Saftnerr@ba.ars.usda.gov)
Chien Yi Wang (Wangc@ba.ars.usda.gov)

Introduction

The Produce Quality and Safety Laboratory (PQSL) group is integrating its multidisciplinary expertise in postharvest physiology, plant physiology, plant pathology, microbiology, horticulture and food science to conduct fundamental and applied research on fresh produce. Our goal is to develop technology to maintain and enhance food safety and quality of fresh and fresh-cut fruits and vegetables. Specific goals are: 1) to understand changes of plant metabolic process, food-born microbial attachment, growth and survival, and host-pathogen interactions as influenced by post-harvest handling, agricultural practice, and fresh-cut preparation conditions; 2) to devise intervention strategies to eliminate or control the presence and/or growth of foodborne pathogens using biocontrol agents, ozone, electrolyzed water, and other physical/chemical approaches; 3) to develop integrated strategies to maintain quality of fresh and fresh-cut product using CA and MAP, varietal selection, preharvest growing strategies, and other emerging technologies such as 1-MCP; and 4) to advance quality evaluation technology by integrating sensory and instrumental analysis of texture in fresh and fresh-cut produce.

Collaborative Project Titles with Other S-294 Members:

Improving food safety and quality of fresh-cut produce (Drs. Yaguang Luo and Hao Feng)

Publications

1. Allende, A., McEvoy, J., Luo, Y. and Wang, C.Y. 2005. Effectiveness of two-sided UV-C treatments in inhibiting natural microflora and extending the shelf-life of minimally processed 'Red Oak Leaf' lettuce. J. Food Microbiology. In press.
2. Leverentz, B., Conway, W. S., Janisiewicz, W. J., Abadias, M., Kurtzman, C. P., and Camp, M. J. 2005. Biocontrol of the food-borne pathogens *L. monocytogenes* and *Salmonella enterica* Serovar Poona on fresh-cut apples with naturally occurring bacterial and yeast antagonists. Appl. Environ. Microbial. 72:1134-1140.
3. Ruiz-Cruz, S., Luo, Y., Gonzalez, R.J., Tao, Y., Gonzalez, G. 2006. Effect of Acidified Sodium Chlorite Applications on Microbial Growth and the Quality of Shredded Carrots. J. Food Ag. In press.
4. Saftner, R. A., Abbott, J. A., Lester, G., Vinyard, B. T. 2006. Sensory and analytical comparison of orange-fleshed honeydew to cantaloupe and green-fleshed honeydew for fresh-cut chunks. Postharvest Biology Technol. In press.
5. Saftner, R. A., Abbott, J. A., Bhagwat, A. A., Vinyard B. T. 2005. Quality

measurement of intact and fresh-cut slices of Fuji, Granny Smith, Pink Lady, and GoldRush apples. J. Food Sci. 70:S317-S324.
6. Vargas, A., Kim, M., Tao, Y., Lefcourt, A., Chen, Y.R., Luo, Y.,Song, Y. 2005. Fecal contamination detection and classification on cantaloupes using hyperspectral fluorescence imagery. J. Food Sci. 70 (8): 471-0476.

Funded Proposals & Grants pertaining to fresh-cut produce

- Luo, Y. Evaluate the effect of SmartFresh™ treatment concentration and application time on the quality and shelf-life of fresh-cut watermelons (A trust fund with AgroFresh, Inc. Springhouse, PA).
- Luo, Y. and McEvoy, J. 2006. Investigate "Bacterial Pathogen Transfer Rates through Perforated Films"; A Trust Fund with Amcor Flexibles Corp. (United Kingdom).

Work in Progress:

William Conway. In collaboration with Drs. Maribel Abadias, Britta Leverentz, and Wojciech J. Janisiewicz, fresh - cut apples contaminated with either *L. monocytogenes* or *S.* Poona, both foodborne pathogen strains from outbreaks on produce, were treated with one of seventeen antagonists originally selected for their ability to inhibit fungal postharvest decays on fruit. While most of the antagonists allowed for increasing growth of the foodborne pathogens on fresh-cut apple tissue, four antagonists, including *Gluconobacter asaii* (T1-D1), a *Candida spp., Discosphaerina fagi* and *Metschnikowia pulcherrima* prevented their growth or survival. The contaminated apple tissue plugs were stored for up to seven days at two different temperatures. The four antagonists survived or grew on the apple tissue at 10 or 25°C. These four antagonists reduced the *L. monocytogenes* populations and except for the *Candida spp.* (T4-E4), also reduced *S.* Poona populations. The reduction was higher at 25°C than at 10°C, and the growth of the antagonists, as well as pathogens, increased at the higher temperature.

Yaguang Luo. The major research activities in Dr. Luo's research program include the evaluation of the effects of the SmartFresh application on the quality and shelf life of fresh-cut watermelons, broccoli, and tomatoes, as well as the influence of fresh-cut preparation conditions on microbial growth. In collaboration with Drs. R.A. Saftner, J. Abbott, J.L. McEvoy and H. Feng and AgroFresh Inc., Dr. Luo evaluated the effect of 1-MCP application time and concentration on quality retention of fresh-cut watermelons. Dr. Luo collaborated with Dr. H. Feng (UIUC) on the investigation of the surface topography of fresh-cut fruits, as well as washing conditions on the removal of pathogenic bacteria. Dr. Luo also developed a novel application of a chemical substance with dual effectiveness in browning inhibition and pathogen inactivation and filed a patent application on this. Dr. Luo also collaborated with Dr. Jim McEvoy to evaluate the effect of micro perforamtion of packaging film on the potential of pathogen transfer. In collaboration with Dr. W. Conway and AirOcare Inc. (Rockville, MD), Dr. Luo investigated the effect of ozone and active oxygen on ripening delay and shelf life extension of bananas, strawberries and grapes.

Robert Saftner. In collaboration with Dr. Bhagwat, have shown that an in-house processing aid/preservative formulation maintains the analytical, sensory and microbial

quality and food safety of fresh-cut apple products: the formulation prevented contamination and growth of *Lysteria monocytogenes* and *Salmonella* spp. on packaged apple slices contaminated with low concentrations (<20 cfu g^{-1}) of the human pathogens and inhibited contamination and growth at higher pathogen concentrations.

In collaboration with Gene Lester, have evaluated the analytical, microbial and sensory quality attributes of a netted, orange-fleshed hybrid melon bred specifically for the fresh-cut industry in the winter season. Consumers liked the flavor, texture, sweetness and overall eating quality of the hybrid chunks better than those of its inbred parents and winter-available honeydew and as well or better than that of winter available cantaloupe. Hybrid fruit stored 5 weeks under refrigeration and MA conditions, then fresh-cut and stored 14 d in air at 5 ˚C maintained good quality (F_{max} = 51N, SSC >12%, surface pH 6.0, β-carotene and ascorbic acid concentrations = 14 and 182 mg kg^{-1}, respectively) and showed no signs of tissue translucency or surface pitting despite microbial populations approaching 8 log cfu g^{-1}.

In collaboration with Drs. Luo and McEvoy, have evaluated the efficacy of 1-MCP treatment of whole watermelon at maintaining the analytical quality of whole and fresh-cut watermelon exposed to ethylene. Results indicated that low (0.5 and 1.0 μL L^{-1} for 18 h at 20˚C) dosage 1-MCP treatments of whole watermelons prevented ethylene-mediated quality deterioration in fresh-cut slices but did not otherwise maintain the quality or shelf stability of watermelon slices stored under modified atmospheric conditions at 5 ˚C.