

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

2007-2008 Activities Report

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Activities

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

Preliminary work conducted with Lihua Fan and Khaled Nagy (Egypt) indicates that incorporation of antimicrobial compounds in starch-based edible coatings inhibits microbial growth on fresh-cut butternut squash. Coatings in combination with MAP increased the shelf-life of fresh-cut squash from 6 days in controls to about 16 days in anti microbial treatments. (Charles Forney et al.)

Pre and postharvest treatments are being assessed with Lihua Fan and Nova Agri Inc. to prolong the market-life of a variety of fresh-cut products including onions, peppers, squash, and carrots. (Charles Forney et al.)

Experiments conducted by Peter Toivonen has shown that apple slices packaged in micro-perforated film had a fruitier aroma when compared with slices packaged in conventional solid film modified atmosphere packaging. Experiments are planned to use both sensory and instrumental measures to assess these effects of packaging on apple slice aroma. The differences in package material characteristics and the internal atmospheres will be evaluated to determine if differences are due to interactions with the packaging material or due to package atmosphere effects (Charles Forney et al.).

The aroma of fresh-cut onions was strongly affected by packaging. Fresh-cut onions sealed in containers made from the biopolymer polylactic acid (PLA) maintained fresh onion aroma after 12 days at 4 °C, while the aroma was rapidly lost in onions held in vented PET containers held in air or in 1% O₂/20% CO₂. Venting PLA containers with a single pin hole caused a rapid loss of onion aroma volatiles (Charles Forney).

Objective 3. Improve understanding of biochemical, physiological and molecular mechanisms that affect fresh-cut product quality.

A new project was recently funded to study postharvest flavor loss of whole and fresh-cut fruits and vegetables. This project will assess the role of metabolic and diffusional mechanisms contributing to aroma and flavor loss during product storage and marketing. The effects of atmosphere modification, interactions with packaging materials, and postharvest treatments on flavor will be assessed to determine mechanisms of flavor loss and develop technologies to preserve flavor(Charles Forney et al.).

The ecology of human enteric pathogens in packaged fresh horticultural products is being studied using spinach/lettuce and *Listeria/E. coli* 0157 surrogates as model systems. Conventional culture based methods, in vitro enhancement/inhibition assays, fluorescent-stain microscopy, and microbial community profiling are being used to determine the role of plant tissue, its condition (whole, cut) and its native bacterial population in the colonization, persistence, and multiplication of human pathogens on vegetables. (Greg Bezanson et al.)

Objective 4. Standardize methods for recovering pathogenic and spoilage microorganisms from intact and fresh-cut produce including tree nuts.

Novel microbiologic and molecular methods to assess the safety of leaf lettuce are being evaluated through lab and field studies designed to detect and estimate the persistence of fecal contamination events by monitoring variations in the ratios of atypical to total coliform or fecal bacteria present on spinach and lettuce and the relative proportions of six major *E. coli* genotypes on plant tissue and in irrigation water and soil (Greg Bezanson as part of a team funded by the Ontario Ministry of Agriculture, Farming and Rural Affairs)

Objective 5. Evaluate and control unintentional and intentional microbial contamination of intact and fresh-cut produce.

The assessment and management of risk to human and environmental health from microbial contamination from animal and human wastes is being assessed through soil and plant applications of liquid dairy manure and naturally contaminated irrigation water to romaine lettuce plots. Standard and chromogenic-media detection and quantification coupled with isolate DNA typing are being used to follow migration, colonization and persistence rates of *E. coli* under field conditions (Greg Bezanson et al.).

A project titled “Mitigating dissemination of bioterrorism agents in Canadian food systems” was recently funded by the Canadian Department of National Defense Research and Technology Initiative Program. A part of this project will assess the stability and behavior of candidate surrogate bacterial, viral and protozoan strains in soil, water and romaine lettuce plants. Selected strains will be introduced via inoculated liquid dairy manure and irrigation water. Substrate optimized isolation, enrichment, and concentration protocols will be developed to provide material for surrogate detection and quantification via culture, immuno-magnetic separation and quantitative PCR-based methods. Trials will be duplicated in BC using different soils, microclimates, plant and cultivar. (Greg Bezanson et al.)

Publications:

- Fan, L., C.F. Forney, J. Song, C. Doucette, M. A. Jordan, K.B. McRae and B.A. Walker. 2008. Effect of hot water treatments on quality of highbush blueberries. *J. Food Sci.* (In press).
- Fan, L and J. Song. 2008. Microbial quality assessment methods for fresh-cut fruits and vegetables. *Stewart Postharvest Review* (in press, will be published in June issue).
- Forney, C.F. 2008. Flavour loss during postharvest handling and marketing of fresh-cut produce. *Stewart Postharvest Review* (in press, will be published in June issue).

- Hildebrand, P.D., C.F. Forney, J. Song, L. Fan, and K.B. McRae. 2008. Effect of a continuous low ozone exposure (50 nL L^{-1}) on decay and quality of stored carrots. *Postharvest Biol. Technol.* (In press).
- Song, J. and C.F. Forney. 2008. Flavor volatile production and regulation in fruit. *Canadian J. Plant Sci.* (In press).
- Forney, C.F. 2008. Optimizing the storage temperature and humidity for fresh cranberries: a reassessment of chilling sensitivity. *HortScience* 43(2):439-446.
- Forney, C.F. 2007. New innovations in the packaging of fresh-cut produce. *Acta Hort.* 746:53-60.
- Allan-Wojtas, P., C.F. Forney, L. Moyls and D.L. Moreau. 2007. Structure and gas transmission characteristics of microperforations in plastic films. *Packaging Technol. Sci.* 20 (in press).
- Forney, C.F., J. Song, P.D. Hildebrand, L. Fan, and K.B. McRae. 2007. Interactive effects of ozone and 1-methylcyclopropene on decay resistance and quality of stored carrots. *Postharvest Biol. Technol.* 45:341-348.
- Song, J., P.D. Hildebrand, L. Fan, C.F. Forney, W.E. Renderos, L. Campbell-Palmer, and C. Doucette. 2007. Effect of hexanal vapor on the growth of postharvest pathogens and fruit decay. *J. Food Sci.* 72(4):108-112.
- Fan, L., J. Song, K.B. McRae, B.A. Walker and D. Sharpe. 2007. Gaseous ozone treatment inactivates *Listeria innocua* in vitro. *Journal of Applied Microbiology.* 103:2657-2663.