

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

2007-2008 Activities Report

Institution: University of Florida

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Introduction:

The University of Florida Horticultural Sciences Department group is investigating the role of ethylene, tissue senescence and chilling injury in the loss of quality during handling of fresh-cut products, with sensory evaluation and aroma volatile measurement being done in collaboration with Food Science and also ARS-Winter Haven. The survival, proliferation and control of microorganisms on raw material and fresh-cut products are being investigated jointly by Food Science and Plant Pathology.

Activities

Objective 1. Develop, evaluate, and standardize subjective and objective quality evaluation methods in intact and fresh-cut fruits and vegetables. (Brecht)

The catechol and nitroso visual assays of Kader and Chordas (1984) were adapted using fresh-cut mango slices to visualize the distribution of PPO and phenolics, respectively, within the mesocarp.

Digital images of several fresh-cut products have been associated with previously developed rating systems for inclusion in the database developed by project participants at UC Davis.

Objective 2. Develop new strategies to maintain fresh-cut product quality. (Brecht, Huber, Sargent, Sims)

The effects of the mango hot water quarantine treatment (T102-a) on the visual, and compositional quality factors, aroma volatile production, respiration rate, and electrolyte leakage of fresh-cut 'Kent' mango slices (*Mangifera indica*) stored at 5°C for 10 days was investigated. The results suggest that the quarantine hot water treatment does not significantly affect the quality or shelf life of fresh-cut mango.

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

The role of ethylene-action in quality changes and shelf-life of intact versus fresh-cut melon fruit was investigated using pretreatment with 1-methylcyclopropene (1-MCP). Inhibition of ethylene

action by 1-MCP reduced tissue watersoaking, improved firmness retention, and suppressed electrolyte leakage. The development of watersoaking or tissue translucency was accompanied by an accumulation of lipases, carbohydrate-degrading enzymes, and up-regulation of genes encoding these and other, unidentified proteins.

The apparent lack of chilling injury symptom development in fresh-cut tropical and subtropical species in terms of more basic physiological responses of the tissues to chilling stress such as textural alterations and aroma volatile production is being investigated using whole and fresh cut 'Kent' mangoes (*Mangifera indica*) stored at chilling (5°C) and non-chilling (12°C) temperatures. Aroma volatile production (based on the quantification of 16 aroma volatiles) did not differ among whole fruit and fresh-cut slices stored at chilling or non-chilling temperatures with the exception of ethanol, which was lower in whole fruit and slices stored at 5°C. Electrolyte leakage was higher in fresh-cut slices than whole fruit, but no conclusion could be made as to the effect of storage temperature. It is unclear whether the storage period at 5°C was sufficiently long to cause chilling injury (CI) in fresh-cut mango slices since no visual CI symptoms developed in the whole fruit. However, reduced ascorbic acid content and increased softening at 5°C suggest that the fresh-cut slices did experience chilling stress.

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

A method using flow-through immunocapture (FTI) with real-time PCR was developed and demonstrated for detection of several human microbial pathogens on smooth tomato surfaces and in potato salad and ground beef within 8 hours. Food samples were inoculated with an appropriate dilution of a five-serovar *Salmonella* cocktail and enriched for 5 h. Following enrichment, samples were analyzed by the FTI-XLD and FTI-PCR methods. Food samples were also analyzed by a modified U.S. Food and Drug Administration *Bacteriological Analytical Manual* (BAM) *Salmonella* culture method for comparison. The FTI method demonstrated the ability to isolate presumptive *Salmonella* colonies up to 48 h faster than did the modified BAM *Salmonella* culture method.

Objective 5. Evaluate and control unintentional and intentional microbial contamination of intact and fresh-cut produce. (Bartz, Schneider)

Survival and growth of *Bacillus atrophaeus* and *Salmonella* spp. and effectiveness of sanitizer treatments in inactivation of *Salmonella* on fruit or vegetable surfaces was shown. The effect moist heat treatment on infesting bacterial endospores was investigated. Recovery studies suggested a less than 2-log₁₀ unit reduction of inoculated *B. atrophaeus* spores after a 3-minute, 85°C moist heat treatment, and no heat injury symptoms developed on cantaloupe melons during storage for 2 weeks at 5°C. Increasing treatment temperature from 75 to 95°C resulted in no increase in efficacy in terms of recovery of indigenous vegetative bacteria. The results suggest that aqueous heat treatment is not a suitable method for reducing populations of the resting structures of spore-forming bacteria from the surface of netted muskmelons.

The effect of ethylene on the survival of *Salmonella* cells residing on unwounded surfaces of tomato fruit was investigated. Fruit were held at 20°C and 95% relative humidity after surface inoculation with the low virulence and rifamycin-resistant pathogen *S. enterica* ssp. *enterica* serovar Typhimurium strain LT2 (*S. Typhimurium*). Tomato fruit were treated either with a air or

with 150 ppm ethylene in air. The results suggest that although Salmonella can survive on the surfaces of tomato fruit in typical ripening rooms, proliferation of Salmonella is neither promoted nor inhibited by ethylene exposure.

Projects for 2008-2009

- Work with project participants from UCD (Saltveit) and ARS-FL (Baldwin), we will compile methods being used by project participants for sensory and instrumental quality analysis and write draft guidelines for testing fresh-cut products. (Brecht)
- Determine if MAP can be developed to allow riper fresh-cut mango to be held at higher temperature with adequate shelf life and better aroma retention.
- The role of membrane deterioration in terms of electrolyte efflux and analysis of lipoxygenase and phospholipase action in limiting the shelf-life of fresh-cut fruits will be investigated. Rinsing the cut fruit with buffered alkaline solution will also be tested to determine if hyper-acidification of the cut surface due to vacuole rupture might play a role in the development of watersoaking and softening due to activation of hydrolases in the cell wall and membrane. (Huber)
- We will continue characterizing microbial survival, growth, and contamination mechanisms on fresh-cut products and develop and test management and intervention strategies that may be applied during production and/or processing to eliminate or control pathogen contamination in these products. (Bartz & Schneider)

Publications:

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5. Mahovic, M., J. Shukla, R.M. Goodrich-Schneider, M.V. Wood, J.K. Brecht, and K.R. Schneider. 2008. *Bacillus atrophaeus* spore survival on netted muskmelon surfaces after moist heat treatment. HortTechnology 18:53-58.
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