

**Southern Regional Multi-State Research Project S-294  
Postharvest Quality and Safety in Fresh-Cut Vegetables and Fruits**

**2007-2008 ACTIVITIES REPORT**

**INSTITUTION**                      The University of Georgia Department of Food Science & Technology, Athens and Griffin campuses

**PARTICIPANTS**

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**INTRODUCTION**

The University of Georgia's Food Science and Technology Department was fortunate to receive two of nine *Fresh Express* competitive research grants awarded in May of 2007. This funding targets studies on *E. coli* O157:H7 contamination of spinach and iceberg lettuce. One UGA project, "Subsurface contamination and internalization of *E. coli* O157:H7 in pre-harvested lettuce" is being led by Dr. Michael Doyle of the Center for Food Safety, in Griffin, Georgia. The other project, "Fate of *E. coli* O157:H7 on fresh and fresh-cut iceberg lettuce and spinach in the presence of normal background microflora" is led by Dr. Mark Harrison, on the Athens campus of UGA.

Although no manuscripts from these two projects have been published to date, the specific objectives of each grant are listed below under Current/Ongoing Activities for Objective 5.

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

**CURRENT/ONGOING ACTIVITIES**

- **Doyle, M.P.** (Principal Investigator), **L.R. Beuchat**, **M.C. Erickson**, G. Zhang, and L. Ma. Subsurface contamination and internalization of *E. coli* O157:H7 in pre-harvested lettuce. *Fresh Express* grant.  
In this project, studies will determine (1) strain differences among *E. coli* O157:H7 isolates to internalize, colonize, survive and grow on and in lettuce plants; (2) the degree of internalization of *E. coli* O157:H7 and its subsequent survival and growth in different types of lettuce and at different phases of the plant's growth cycle; (3) the role of environmental stress (heat or water) and soil fertility on the level of internalization of *E. coli* O157:H7 in lettuce; the effect of level of contamination on the extent of internalization, colonization, and survival/growth of *E. coli* O157:H7 in and on lettuce plants; (5) the effect of insect damage to lettuce leaf tissue on internalizing *E. coli* O157:H7 and its subsequent survival/growth; (6) survival and possible internalization of *E. coli* O157:H7 in lettuce as a function of location of

contamination (abaxial or lower leaf surface vs. adaxial or upper leaf surface); (7) the contribution of soluble organic matter (simulating materials in which *E. coli* O157:H7 can be found) on survival of *E. coli* O157:H7 on lettuce surfaces; and (8) the level and site of contamination of iceberg lettuce when cored by an *E. coli* O157:H7-contaminated knife.

- **Harrison, M.A.** (Principal Investigator), W. Kerr, **W.C. Hurst**, H. Doering. Fate of *E. coli* O157:H7 on fresh and fresh-cut iceberg lettuce and spinach in the presence of normal background microflora. *Fresh Express* grant.  
The goals of this project are (1) to determine the ability of *E. coli* O157:H7 to multiply in the presence of normal background microflora on iceberg lettuce and baby spinach; (2) to simulate commercial conditions and practices for handling spinach and lettuce to allow the evaluation of the fate of *E. coli* O157:H7 on produce during typical handling operations; (3) to isolate naturally-occurring microorganisms that may be present on spinach and lettuce under different handling conditions that may show inhibitory activity toward *E. coli* O157:H7; and (4) to provide insight into how *E. coli* O157:H7 interacts with naturally-occurring microflora on lettuce and spinach such that the knowledge can be used in analyzing what produce handling and packing routines might be beneficial or detrimental in reducing contamination related to this pathogen.

## **COMPLETED/PUBLISHED ACTIVITIES**

- Dr. Mark Harrison and Jin Kyung Kim found that ice made from water contaminated with *E. coli* O157:H7 can spread the pathogen to other heads of romaine lettuce in a shipping container as the ice melts.
- Drs. Marilyn Erickson, Michael Doyle, Larry Beuchat, *et al.* determined that lettuce leaves or roots grown in soil contaminated by *E. coli* O157:H7 or *Salmonella* spp. did NOT internalize the pathogens. Conversely, these pathogens on the surface of the lettuce leaves were quickly internalized.
- Dr. Mark Harrison and Jin Kyung Kim have studied the methods of attachment on romaine lettuce by non-pathogenic *E. coli* ATCC 25922 and believe it would be a useful surrogate for *E. coli* O157:H7 for studies involving attachment and recovery from chilled produce.
- Dr. Larry Beuchat and D.A. Mann tested methods that *Salmonella* used to attach itself to raw Roma, round and grape tomatoes. *Salmonella* grew in the stem scar and pulp tissues of all three varieties of tomatoes at 12° and 21°C, but not at 4°C. It would not grow on the skin of grape tomatoes at any temperature.
- Dr. Bill Hurst, Dr. Mark Harrison and MS candidate Deann Akins examined the effect of washing practices at Georgia cantaloupe packing houses on microbial contamination. Although hot water sanitizing was slightly more effective than chlorinated dump tanks in reducing counts, temperatures in the dump tanks could not be sustained. Microbial populations on melons increased slightly after removing melons from the dump tank, suggesting post-process contamination after washing.

## **JOURNAL ARTICLES**

- Akins, E.D., **M.A. Harrison** and **W.C. Hurst**. 2008. Effect of washing practices on the microflora on Georgia-grown cantaloupes. *J. Food Prot.* 71(1): 46-51.
- Kim, J.K, and **M.A. Harrison**. 2008. Transfer of *Escherichia coli* O157:H7 to romaine lettuce due to contact water from melting ice. *J. Food Prot.* 71(2): 252-256.
- Palumbo, M S., J. R. Gorny, D.E. Gombas, **L.R. Beuchat**, C.M. Bruhn, B. Cassen, P. Delaquis, J.M. Farber, L.J. Harris, K. Ito, M.T. Osterhold, M. Smith, and K.L.J. Swanson. 2007. Recommendations for handling fresh-cut leafy green salads by consumers and retail food service operators. *Food Prot. Trends* 27:892-898.
- M.P. Doyle**, and **M.C. Erickson**. 2008. Summer meeting 2007 - the problems with fresh produce: an overview. *J. Appl. Microbiol.* 2008 Feb 13; epub PMID:18284485.
- Erickson, M.C.**, and **M.P. Doyle**. 2007. Review: Food as a vehicle for transmission of Shiga Toxin-producing *Escherichia coli*. *J. Food Prot.* 70(10):2426-2449.
- Simmons, K., **M.A. Harrison**, **W.C. Hurst**, J.A. Harrison, J.K. Brecht, K.R. Schneider, A. Simonne, and J. Rushing. 2007. Survey of food defense practices in produce operations in the southeast. *Food Protect. Trends.* 27(3):174-184.
- Vojdani, J. D., **L. R. Beuchat**, and R. V. Tauxe. 2008. Juice-associated outbreaks of illness in the United States, 1995-2005. *J. Food Prot.* 71(2):356-364.
- Beuchat, L.R.** 2007. Managing food safety risks in the fresh-cut industry. *Acta Hort.* 746:102-110.
- Hurst, W.C.** 2007. Quality Assurance and Safety Consideration for Fresh-cut Produce. *Acta Hort.* 746: 115-122.
- ## **ABSTRACTS**
- Beuchat, L.R.** 2007. Managing food safety risks in the fresh-cut industry. Book of Abstr., Int. Conf. Quality Management of Fresh Cut Produce, 6-8 August, Bangkok, Thailand. p. K1-12.
- Erickson, M.**, D. Riley, J. Liao, A. Payton, S. Tison, C. Webb, L. Ma., G. Zhang, **M. Doyle**, and **L. Beuchat**. 2008. Survival and internalization of *E. coli* O157:H7 on and in stressed lettuce plants. Abstract, Annual Mtg., Center for Food Safety, Univ. of Georgia, March 4-5, Atlanta, GA.
- Hurst, W.L.** 2007. Quality Assurance and Safety Consideration for Fresh-cut Produce. Book of Abstr., Int. Conf. Quality Management of Fresh Cut Produce, 6-8 August, Bangkok, Thailand. p. K1-13.
- Mann, D. A., and **L.R. Beuchat**. 2008. Survival and growth of *Salmonella* on round, Roma, and grape tomatoes as affected by stage of maturity. Abstract, Annual Mtg., Center for Food Safety, Univ. of Georgia, March 4-5, Atlanta, GA.