S-294 (2005-2011)

Quality and Safety of Fresh-cut Produce

Researchers examined fresh-cut fruits and vegetables and developed innovative ways to prevent spoilage and reduce the risk of contamination, resulting in higher quality fresh-cut produce, reduced economic losses for the industry, and lower health threats.

Who cares and why?

For the past 15 years, consumption of fresh-cut produce (e.g., salad, carrot sticks, sliced melons) has risen about 10% each year. As of 2010, the market for fresh-cut produce was valued at around $10-12 billion annually, and fresh-cut products made up more than 15% of all fresh produce marketed in the U.S. However, because fresh-cut products spoil easily, more than $1 billion may be lost each year after harvest. In recent years, the number of produce-related foodborne illness outbreaks in the U.S. has increased. Outbreaks cost the U.S. billions of dollars in terms of destroyed food products, medical expenses, and lost wages and worker productivity. If the number of outbreaks continues to rise, consumers will lose confidence in fresh-cut produce and buy less. Currently, the industry relies on practical experience and traditional technologies to preserve fresh-cut produce, but these conventional methods do not pay enough attention to characteristics that keep customers coming back for more, such as extended shelf life, good flavor retention, appealing texture, and food safety. With over 200 different fruits and vegetables that can be sold as fresh-cut products, each with unique properties and handling requirements, effective ways to preserve quality and detect contamination are needed to reduce food spoilage and safety issues. Alternative and emerging technologies should be thoroughly evaluated for impacts on quality, nutritional value, and safety before being introduced to the fresh-cut produce industry.

A cantaloupe's rind can hide pathogens and make it difficult to detect them (photo by Brandon Quester/News21). Researchers also examine leafy greens, which are responsible for 32.9% of produce-related foodborne illnesses from 1996 to 2008 (photo by Richard North). This food safety research can be applied to a wide variety of other fresh-cut products (like the fruit salad below, photo courtesy of *www.sweetonveg.com*).

What has the project done so far?

Over the past five years, laboratories from multiple states and disciplines have worked together to develop and publish guidelines for measuring and screening fresh-cut produce quality. S-294 scientists have identified ways to prevent browning, losses in flavor, losses in nutritional value, and changes in texture in apples, citrus, melons, leafy greens, tomatoes, onions, and other produce. Scientists have also coordinated with the fresh-cut industry to design new ways of preparing, packaging, and storing fresh-cut produce to avoid damage and maintain freshness for extended periods of time. To understand food safety risks, scientists have studied how pathogens behave in environmental conditions that occur on harvested crops, in produce handling and processing facilities, and on fresh-cut products. Furthermore, they have researched cleansing techniques and protective coatings that can be applied to the surface of fresh-cut produce to remove or kill disease-causing bacteria. In particular, the S-294 team has received two Fresh Express competitive research grants to study *E. coli* contamination of spinach and iceberg lettuce, and S-294 members have developed effective intervention strategies for leafy green contamination. S-294 scientists have shared their research results with stakeholders through published papers, trade shows, numerous poster presentations, and a website (*http://postharvest.ucdavis.edu*) maintained by the UC-Davis group. Members have also continued to emphasize education and training for undergraduate and graduate students. In addition, S-294 members have worked with commercial partners to patent and market the products and technologies that have resulted from their research.

Impact Statements

Studied physical and chemical properties of fresh-cut produce, resulting in new procedures for handling and processing fresh-cut produce, new criteria for choosing packing materials, and new technologies for controlling ripening and decay. Improved appearance, taste, and shelf life will likely improve nutritional benefits and boost customer satisfaction and confidence. New packaging materials will reduce the industry's environmental footprint.

Developed standard procedures for identifying and evaluating contamination that have been adopted by the USDA, FDA, EPA, and other researchers.

Developed fast, sensitive ways to detect contamination on fresh-cut produce, including a hand-held device that is now used by the industry to survey food processing areas and food surfaces for pathogens. S-294 also developed a food security audit program that has been adopted by fresh-cut produce growers and processors. These efforts have led to higher quality fresh-cut produce, fewer threats to human health, and savings due to reduced product losses and fewer and earlier recalls.

Presented educational and training courses to industry members, spreading knowledge and resources that protect product quality and safety.

Changed attitudes towards food safety issues, helping FDA, industry members, and customers accept irradiation (exposing food to radiation that is harmless to consumers, but destroys microorganisms present in the food) as a safe technique.

Want to know more?

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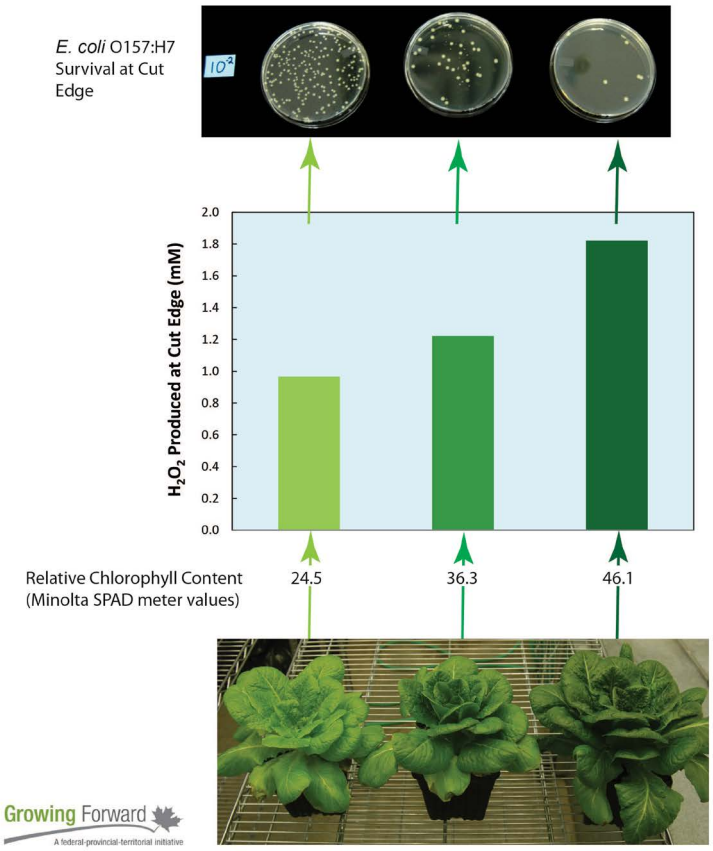
Agriculture and Agri-Food Canada

Lettuce chlorophyll content impacts food safety outcomes in fresh-cut Romaine lettuce. Healthier, darker green lettuce has lower *E. coli* O157:H7 survival after cutting.



What research is needed?

Due to the relatively short shelf lives of most fresh-cut produce, rapid methods for detecting contamination are of special importance. During future testing of new ways to remove and kill germs, research should pay special attention to the potential for unexpected interactions when multiple methods are used simultaneously. There is also a need for direct measures of the effectiveness of intervention strategies as well as improved computer model systems to test their effectiveness before they are used in real settings. Continued collaboration among laboratories is needed so that new research questions are addressed using standard protocols that make it easier to compare and apply results. Integration of disciplines is also needed to ensure that the technologies developed are effective and practical.

This project was supported by the Multistate Research Fund (MRF) established in 1998 by the Agricultural Research, Extension, and Education Reform Act (an amendment to the Hatch Act of 1888) to encourage and enhance multistate, multidisciplinary research on critical issues that have a national or regional priority. For more information, visit *http://saaesd.ncsu.edu/*.

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