



Director's Update

As we prepare for our annual [Postharvest Short Course](#), I always make an effort to include current information on topics that frequently arrive at our desk. In relation to control of postharvest decay and spoilage, I have received numerous requests over the years for information or opinion on the commercial use of plant essential oils as spray-on treatments, incorporated into waxes, and embedded into packaging materials. More recently, these same questions have been focused on preventive or corrective control of foodborne bacterial pathogens. In two different grower trainings this month, the virtues of various extracted plant volatiles, essential oils (EO), were touted by some attendees as the best alternative treatments for decay control and food safety. One specific application, slow-release nano-encapsulation of EO in waxes and packaging films, was suggested to be an effective strategy based on recent trade articles. These brief summary articles follow a number of similar trade articles that typically cite a recent journal publication and some strong claims in their conclusions.



The purification of EO for a variety of uses extends back several centuries, including for their properties as preservatives, antimicrobials and pesticidal treatments. The interest in EO for plant pathogen control, in both preharvest and postharvest environments, stimulated by the quest for effective non-synthetic bactericides, fungicides, and nematicides, caused a surge in research investments and publications. A simple term search identifies over 18,000 articles, reviews, and book chapters in the past three decades. Focusing on recent studies involving EO to control foodborne pathogens on fruits and vegetables, results identify over 2,000 publications listed in Google Scholar from 2015 to 2017.

Despite all the effort, it has been a challenge to find an EPA-labeled and sustained commercial product suitable for use in postharvest control of either plant or human pathogens on produce. The first registered formulations were approved by EPA in 1947 and generally recognized as having very low acute toxicity, earning a Generally Recognized As Safe (GRAS) classification by FDA. One product for plant pest management that has maintained a presence over the years is EF 400 (<http://anjonag.com/labels-msds/>), a blend of several EO. I have highlighted this formulation for several years in our Short Course, including a profile of uses in the Organic Postharvest module, as several other researchers also found evidence for practical plant pathogen control, though at fairly high doses.

One recent article, on which I was asked to comment, is provided as a source link below. Briefly, the results reported are consistent with a plethora of similar articles concluding that significant reduction in disease occurrence or severity are observed under controlled conditions. The challenge is for industry to determine whether these publishable, but partial, reductions are economically significant and fit current handling and packing practices. One never knows, but experience leads me to be a fairly ardent skeptic. EO have well-recognized commercial uses in other foods and other horticultural applications (i.e. sprout inhibition in potatoes) but postharvest decay control has not been a sustained industry experience or practice. *Cinnamaldehyde inhibits the mycelial growth of Geotrichum citri-aurantii and induces defense responses against sour rot in citrus fruit* (Wu et.al. 2017)
www.sciencedirect.com/science/article/pii/S0925521416302708.

The use of these products as antibacterials for foodborne pathogens in postharvest water or as spray-on materials falls in the gray-zone of GRAS but not EPA-labeled for this purpose by registrants. There is a lot of interest in these alternative chemistries and we will explore some of the data in our [Advanced Produce Safety Workshop](#), November 8-9, 2017. As far as I am aware, given the millions of dollars of research funding awarded by USDA programs for efficacy and performance studies on fruits and vegetables, no practical and affordable treatments have emerged or are realistically on the horizon. I would be happy to learn if I am wrong in this assessment.

For those interested in an overview of the research evidence and applications of EO as sprays, dips, and incorporated into packing films, I recommend *State of the Art of Antimicrobial Edible Coatings for Food Packaging Applications* (Valdés et.a. 2017)
<http://www.mdpi.com/2079-6412/7/4/56>.

Postharvest Education at UC Davis



Postharvest Technology of Horticultural Crops Short Course June 19-20, 19-23 and 26-30, 2017

Once again, we are hosting a full house of 115 at our annual Short Course, and as always, we have a dynamic and international group of attendees. Our Short Course is a good opportunity to get a solid foundation in postharvest biology and technology or catch up on new developments, and is always a great event to build networks and connect with other produce professionals from around the country and world. We hope to see you next year!

[Read More](#)



Fresh-Cut Products: Maintaining Quality & Safety Workshop September 26-28, 2017

This workshop provides an intensive and substantive overview of many aspects of fresh-cut production, processing, packaging, distribution and quality assurance. Participants gain working knowledge of established and new procedures through topic-related sessions and demonstrations.

Registration is now open!

[Read More](#)

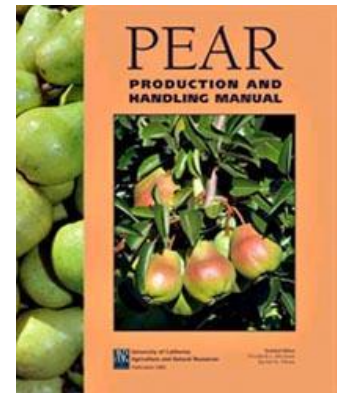
Featured Postharvest Bookstore Item

Sale! Receive 25% off Pear Production and Handling Manual

This publication provides basic information on the growth and fruit development of pears, as well as practical considerations on pear culture. It was written with California Bartlett pear production in mind, but will be useful for worldwide growers of all pear varieties.

Also included is information on orchard and tree management (including varieties), propagation and rootstock selection, training pruning, orchard floor management, irrigation, fertilization, irrigation systems, frost protection, nutrition, pest management, harvesting, and extensive information on postharvest storage and handling.

Use sale code [PearManual25](#) to apply your discount. For a complete listing of all our publications see our [bookstore](#).



Postharvest Specialists' Updates & Other News



Trevor Suslow Stays Local to Further FSMA Considerations

Trevor attended as a panel member at the Agricultural Issues Council held in Monterey. This event was hosted by Zenith Insurance Company of Fresno, CA and covered a wide range of "hot topics" including labor, environment, advanced technologies for Ag, and FSMA/food safety implementation and compliance challenges. Trevor also was Co-Instructor in Sacramento for the Produce Safety Alliance Grower Training curriculum provided to a statewide group of CDFA inspectors and auditors. A number of industry concerns for the trend to blend USDA GAPs/GHPs requirements with FSMA Produce Rule and Preventive Controls provisions in on-site audits was shared to this group. If you have had this experience, please send us a brief description and your understanding of the conflict in compliance planning that was created. We are currently working with USDA and CDFA to identify these misunderstandings and provide clarification and standardization of assessments.

Resource Spotlight

Food Safety Practices and Costs Under the California Leafy Greens Marketing Agreement

Emeritus Postharvest Center Specialist Roberta Cook and Emeritus UC Davis Cooperative Extension Specialist, Karen Klonsky, are co-authors with Helen Jensen of Iowa State and lead author Linda Calvin of the USDA Economic Research Service (<https://www.ers.usda.gov>). Two versions, short and full, of their studies were recently released for public access (links below). The body of the data and analysis resulted from in-depth interviews with firms participating in the voluntary California Leafy Greens Marketing Agreement provide information on incremental costs that U.S. firms can expect to incur if integrating provisions to meet new Food Safety Modernization Act compliance standards.

<https://www.ers.usda.gov/publications/pub-details/?pubid=83770>
<https://www.ers.usda.gov/amber-waves/2017/june/the-california-leafy-greens-industry-provides-an-example-of-an-established-food-safety-system/>



On Our Website

Stay up-to-date with the Postharvest Technology Center by joining our [LinkedIn Group](#).



New Publications on our Website

Sandra Escribano, Nobuko Sugimoto, Andrew J. Macnish, William V. Biasi, Elizabeth J. Mitcham 2017. [Efficacy of liquid 1-methylcyclopropene to delay ripening of 'Bartlett' pears](#). *Postharvest Biology and Technology* 126 (2017) 57–66

A.I. Deltsidis, J.K. Brecht, J. Bai and E.A. Baldwin 2016 [Tomato chilling injury threshold defined by the volatile profiles of pink harvested tomato fruit](#) , DOI: 10.17660/ActaHortic.2016.1120.21

Postharvest Calendar

- June 19-30, 2017. [Postharvest Technology of Horticultural Crops Short Course](#). UC Davis Campus and Central CA
- July 2-6, 2017. [IX International Peach Symposium](#). București, Romania.
- September 26-28, 2017. [Fresh-cut Products: Maintaining Quality & Safety Workshop](#). UC Davis Campus
- October 17-20, 2017. [International Postharvest Unlimited Conference \(ISHS\)](#). Madrid, Spain
- November 7, 2017. Produce Safety Alliance Training. Davis area
- November 8-9, 2017 [Advanced Produce Safety Workshop](#). Davis area
- November 29-December 1, 2017. [IX Congreso Iberoamericano de Tecnología Postcosecha y Agroexportaciones](#). Santiago, Chile

Ask the Produce Docs



Q We have had several complaints from consumers about slimy mini-cucumbers in 14 oz. clamshells that still have several days expected shelf-life left. We've been through this a few times and don't see a pattern of when it is going to be a problem. Product gets [washed], dried, and packed the same day and shipped within 48 hours. Our APC counts on the line are very low so we don't think it is bacterial. Cold-chain control is good at [retail] and may be too cold sometimes. These are thin-skinned and the first thing that shows is watersoaked spots in a few days so someone suggested chilling injury. Then they go slimy. There are a few of each on the way. Any thoughts on this? Would you be able to take a look?

A Although we cannot always accept or take on a diagnostic assessment of samples sent to our lab, especially without notice, it was possible to conduct an isolation and characterization due to the characteristic signs on the samples and minor cost involved. The symptoms and timeframe are not consistent with chilling injury. Both the water-soaked lesions and surface slime yielded almost pure *Leuconostoc mesenteroides* subsp. *dextranicum*. We did not inoculate sound cucumbers with purified isolates to verify cause-and-effect, but in my experience, this sliminess is the result of a predisposing factor but not necessarily the core issue. This member of the lactic acid bacteria (LAB) group is very common on many types of produce and can be involved in natural fermentation processes. *L. mesenteroides* can be an opportunistic plant pathogen, causing a sour decay on fruit vegetables, including mature green tomatoes and bell peppers. It can be especially problematic on peeled and shredded carrots causing a wet, slimy surface eventually leading to soft rot. The copious white slime is produced by the cells in the presence of sugars. *L. mesenteroides* occasionally causes similar sliminess and a strong sour odor on packaged shredded cabbage. Although this type of very tender cucumber is often handled and packed dry, [process] may lead to the buildup of *Leuconostoc* on surfaces and especially hard to access locations on equipment. Testing for Aerobic Plate Count won't reveal high populations of these bacteria if cleaning and sanitizing are incomplete. One action, which may be informative, would be to conduct a thorough swab survey of product contact surfaces and request the lab to plate these on de Man, Rogosa and Sharpe Lactobacillus Media (MRS). It is very common to find *L. mesenteroides* on raw product, even in greenhouse crops, in low numbers, which do not cause arrival or storage issues under normal shelf-keeping conditions. High populations of *L. mesenteroides* are often found in the handling situation described and growth is possible at refrigeration temperatures of 34°F and certainly around 45 to 55°F, as described. Even superficial handling injuries can be a serious predisposing factor. If the problem persists or shows up again, this environmental survey for spoilage bacteria may identify a general sanitation issue or a 'hot spot'.

As always, let us know what you worked out.

-Trevor Suslow

End Notes and Disclaimers

Postharvest Questions. If you have a postharvest question you'd like answered, please send it to postharvest@ucdavis.edu, and we'll see if one of our specialists can help.

Archived Items. Link to a data store of all our previous "Ask the Produce Docs" questions, or link to [archived copies](#) of our monthly e-newsletter as PDF documents.

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