Summary of Presentation
Food Safety Session: Ontario Horticultural Crops Conference
February 28, 2002

Presentation Title: Dips and Sanitizers
Presenter: Trevor V. Suslow, Extension Research Specialist. University of CA, Dept. of Vegetable Crops.
tvsuslow@ucdavis.edu

For producers, handlers, shippers, fresh cut processors, foodservice and retailers of perishable edible horticultural commodities there should be no residual question that prevention and redundant reductions microbial food safety are critical components of a comprehensive product management plan. In addition, while quality and safety are distinct attributes of the marketing of fresh produce, systematic attention to improving microbial food safety has been observed to enhance the quality and the quality of handling of the product. Broader recognition of the potential association of diverse microbial pathogens, from field, packing, or fresh cut processing environments, on fresh produce has been the result of recent multi-state outbreaks and severe episodes of source water contamination. Recent release of import and domestic produce survey data, conducted by the U.S. Food and Drug Administration has highlighted the potential for the acquisition of surface contamination at points from field production to distribution. Of 1003 samples collected, from targeted import commodities, 96% were determined to be free of detectable contamination with *Shigella*, *Salmonella*, or *E. coli* O157:H7, bacterial pathogens associated with outbreaks linked to fresh produce. Forty-four samples were found to harbor detectable populations of either *Salmonella* or *Shigella*, with *Salmonella* being the most common pathogen recovered. Interim results of the domestic survey provide similar insight with the majority, over 98%, of samples being free of detectable target pathogens. However, *Salmonella* and *Shigella* were detected on a few samples, which underscore the basic dilemma facing the North American industry. Within the historical and normal modes of operation, the contamination of fresh produce with human pathogens appears to be of low probability but of potentially high consequence. Monitoring and testing for pathogens on perishable horticultural commodities to ensure produce safety is a costly and largely non-informative venture. Improved methods of prevention of environmental contamination and vigilant attention to worker hygiene and sanitary facilities are clearly needed. In conjunction, a better understanding of the performance and limitations of existing produce wash and water disinfection treatments and innovation of new dips and sanitizers for surface and sub-surface contaminants is a clear challenge to the research and development community.

The evaluation of chlorination, chlorine dioxide, acidified sodium chlorite, ozone, active oxidizing radicals from electrolysis, and other various produce washes, dips, and surface sanitizers with and without co-treatments or co-activities (i.e. heat, high pH, low pH, surfactants, brushing, microbial competitors, calcium infusion) has received greater attention in recent years and the results of these tests are being published in great abundance in professional journals and reviews. A capsule overview of all these efforts may be summarized as follows:

- Washing with potable water accomplishes a reduction in surface microbial populations.
- Disinfectants may further reduce microbial populations, primarily on the surface but some may have limited sub-surface activity, particularly in conjunction with co-treatments.
- The range of efficacy of any treatment on a specific commodity or application is broad, from no difference from water alone to a 100 to 1000-fold further reduction.
- Effective doses or treatments may be damaging to the commodity, impractical for the industry, not approved for food use, or present obstacles in worker safety and environmental safety.
- Gaseous or volatile disinfectants can also be efficacious and may provide some sub-surface activity.
- No dip, sanitizer or gaseous treatment may be relied upon or presumed to provide elimination of contamination of produce.
- Natural anatomical, biochemical, and electrochemical features of plant and plant wound surfaces and microbial surface properties are barriers to effective control with all dips and sanitizers tested.
- The difficulty of removal of microbial contamination increases with time of storage.

In the effort to assist the industry in identifying effective products, processes, and methods of removal and disinfection of fresh produce, the research community has been challenged to standardize methods for evaluating and reporting efficacy data. If adopted, the clear benefit will be greater reproducibility and comparability between products and across laboratories. Additionally, better understanding and consistent implementation of systems to monitor, control, and document demand-based disinfectant levels are needed. The ultimate beneficiary will be the industry, which will be able to design and implement Recommended Management Practices with science-based information on performance across multiple options in dips ands sanitizers best suited to the specific application.

Recent Background Literature on Standardization

Beuchat,L., L. Harris, T. Ward, and T. Kajs. 2001. Development of a proposed standard method for assessing the efficacy of fresh produce sanitizers. Journal of Food Protection 64:1103-1109

Beuchat,L., J. Farber, E. Garrett, L. Harris, M. Parish, T. Suslow, and F. Busta. 2001.Standardization of a method to determine the efficacy of sanitizers in inactivating human pathogenic microorganisms on raw fruits and vegetables. Journal of Food Protection 64:1079-1084

Burnett, A. and L. Beuchat. 2001. Comparison of sample preparation methods for recovering *Salmonella* from raw fruits, vegetables, and herbs. Journal of Food Protection 64: 1459-1465

Suslow, T.V. 2001. Water disinfection: a practical approach to calculating dose values for preharvest and postharvest applications. ANR #7256 and http://vric.ucdavis.edu.

Suslow, T.V. Introduction to ORP as the standard of postharvest water disinfection monitoring. Electronically available at http://vric.ucdavis.edu

COMMON DISINFECTANT PROPERTIES	CHLORINE GAS	SODIUM OR CALCIUM HYPOCHLORITE	CHLORINE DIOXIDE
Disinfection Action	High	High	High, better than chlorine
Specificity	Generally effective, including, viruses; reference sanitizer. Limited practical effect on parasitic spores (i.e. *Crytosporidium*). Oxidizer and metabolic poison.	Generally effective, including viruses; reference sanitizer. Limited practical effect on parasitic spores (i.e. Crytosporidium). Oxidizer and metabolic poison.	Generally effective. Recognized for biofilm penetration. Oxidizer.
Speed	fastest	fastest	fast-acting
Form	Compressed gas. On-site injection.	Concentrated hypochlorite solution or powder	On-site generation from precursors, or sodium chlorate and hypochlorite solutions. Some stabilized forms released on acidification.
Stability	Good	Good as powder, fair as liquid	Good
Preparation	Easy	Easy	Complex equipment or procedure
Measurement	Easy. Functional relation to redox potential (ORP).	Easy. Functional relation to redox potential (ORP).	More difficult. Moderately functional relation to redox potential (ORP).
Stability	Good	Good	Moderate
Irritancy	Low	Low	Very irritating vapors
Vapors	None at correct pH	None at correct pH	Typical odor, yellow-green, dangerous
pH impact	Most active at pH of 6-7.5	Most active at pH of 6-7.5	Effective at broad pH, best at 8.5
Temperature	For produce, generally cold water, but heated water up to 52C in use	For produce, generally cold water, but heated water up to 52C in use	Use at low temp to minimize vaporization. Some use of gaseous forms on produce.
Conc.	25 to 200 ppm	25 to 200 ppm, 20,000 ppm limited approval for sprout seed disinfection	3 to 5 ppm
Penetration	Poor	Poor	Poor
Hard Water	Activity decreases in very hard water (>500 ppm)	Activity decreases in very hard water (>500 ppm)	No effect
Organic Matter	Reacts to from chloramines	Reacts to from chloramines	Little influence, even at high organic load
Solution Corrosiveness	Slight to moderate	Slight to moderate	Very Corrosive at low pH
Corrosive off-gassing	Possible, through condensation	Possible, through condensation	Slight corrosion
Other	Very corrosive below pH 6	Very corrosive below pH 6	Vapor space corrosion with high temp.
Best use	Food contact surfaces, water disinfection, smooth produce surfaces	Food contact surfaces, water disinfection, smooth produce surfaces	High organic load situations, smooth or complex produce surfaces, flume water disinfection
Disadvantages:	Requires tight pH and concentration control; highly corrosive, when improperly used; produces corrosive gas above 46C.	Requires tight pH and concentration control; highly corrosive, when improperly used; produces corrosive gas above 46C.	Complex preparation; corrosive in acid solution; very difficult to handle unless preparation is automated