Getting Started:
Resources to Understand and Minimize Microbial Risks to Fresh Produce

Production and Postharvest

On-Farm Food Safety Self Audit and Resource CD-ROM
http://vric.ucdavis.edu

Food Safety Begins On-the-Farm Brochure (English and Spanish)
http://www.gaps.cornell.edu

Overview of Good Agricultural Practices
Final Guidance: Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables (FDA 1998)
http://www.foodsafety.gov/~dms/prodguid.html

System-wide Biosecurity

Food Security and Bioterrorism Checklist - Food Safety and Terrorism
http://www.cfsan.fda.gov/~dms/fsterr.html

Food Security Guidance, Federal Register Notice of Availability (2002)
http://www.cfsan.fda.gov/~lrd/fr020109.html

Guidance for Industry - Food Producers, Processors, Transporters and Retailers: Food Security Preventive Measurers Guidance
http://www.cfsan.fda.gov/~dms/secguid.html

Guidance for Industry - Importers and Filers: Food Security Preventive Measures Guidance
http://www.cfsan.fda.gov/~dms/secguid2.html

Prepared by Trevor V. Suslow, Ph.D.
Extension Specialist
Postharvest Quality and Safety from Seed to Shelf
Dept. of Vegetable Crops
University of California
tvsuslow@ucdavis.edu
http://vric.ucdavis.edu
530-754-8313
530-752-4554 fax

Partial support for the production and distribution of this brochure is contributed by the National Good Agricultural Practices Training Program (USDA CSREES Agreement # 99-41560-0821)

Key Points of Control and Management of Microbial Food Safety For Growers, Packers, and Handlers of Fresh-Consumed Horticultural Products

Introduction:

The majority of fresh consumed fruits and vegetables in the United States are wholesome and free of microorganisms that could result in illness under common and sensible handling and food preparation practices. In addition, many fruits and vegetables have natural barriers that minimize the chance that any surface contamination could be transferred to the internal edible portions, up to the point of harvest. These same barriers may also increase the effectiveness of removal of contamination during washing combined with light to vigorous brushing, depending on the sensitivity of the item. For some tolerant commodities, dry brushing in combination with a volatile antimicrobial treatment and rapid drying is an effective method for surface microbial reduction.

Contamination by microbial pathogens can only result, ultimately, from an external environmental source at some point from production to food preparation. Nonetheless, as with all fruits and vegetables consumed without a cooking step, the best approach to maintaining the wholesome nature and safe consumption of edible horticultural products is to be aware of the potential risks and to systematically identify and establish management practices to minimizing the chance of external and internal contamination at every step from growing to selling. The industry must continue to take a proactive role in delivering this same message to the public in order to assist them safe food handling and preparation.

Created & published by the
University of California
Vegetable Research and Information Center
http://vric.ucdavis.edu

Background:

Whether domestically produced or imported, four key events have brought focus and concern for the microbial food safety of fresh fruits, vegetables, nuts and other edible horticultural foods:

1. Recent reoccurring outbreaks linked to consumption of imported and domestic products.
2. Positive detection and recovery of human pathogens from random survey sampling of both imported and domestically produced produce.
3. Recent reports from several researchers documenting the difficulty of cleaning and disinfecting produce surfaces.
4. Recent reports from several researchers documenting the potential for internalization of pathogens during postharvest handling

Based on the overall consumption of fresh produce, illness definitively associated with contamination that occurs prior to food preparation is a very low probability event. However, it is equally clear that outbreaks linked to fresh produce from various production areas have occurred and have impacted large numbers of individuals across many states and into Canada. While most individuals can recover from foodborne illness without complications or the need for medical attention, some individuals such as the very young, the very old and those who may be otherwise immuno-compromised may suffer complications, including those resulting in death.

The purpose of this brochure is to provide a brief outline of the fundamental components of microbial food safety that should be part of any comprehensive management plan for growers, specialty crop producers, harvest service operators, distribution and wholesale handlers, direct marketers, and fresh cut processors. The diversity of environments, crop management practices, and handling practices make a single approach to food safety planning unrealistic; therefore, this quick reference guide will focus on the key guiding principles of prevention of contamination, reduction of survival, and prevention of cross-contamination for each step, up to consumer handling. Individual food safety planning and management programs may be derived from the application of these principles that are the combined outcome of specific research and practical experience with diverse commodities and crop management systems.

Many of these same principles may be applied to planning for food security and prevention of intentional food contamination. Resources helpful in counter-bioterrorism planning are provided at the end of this document.

What are the Guiding Principles of Food Safety for Fresh Produce?

- Once contaminated, removing or killing pathogens on produce is very difficult.
- Prevention of microbial contamination at all steps from production to distribution is strongly favored over treatments to eliminate contamination that may have occurred.
- Documentation of implementation of prevention programs and food safety awareness training for workers at all levels of the agricultural and packing environments are key signatures of a credible food safety program.

Guiding Principles for Crop Production Water

Wherever water comes into contact with fresh produce, its quality may directly determine the potential for persistent pathogen contamination.

- Become familiar with the routes and handling of surface water sources, seasonal influences on quality, and any microbial monitoring programs of the supplier (for delivered water from public or private irrigation districts).
- Identify potential sources of contamination that affect your water, especially those that are within your ability to control in a manner that will protect its quality.
- Ensure that wells are designed and maintained in a manner that prevent surface run-off or soil infiltration from contaminating the water supply.
- Water used for all foliar applications should be from a pathogen-free source.
- Until more research data is available, it is strongly recommended that any foliar applications within two weeks of harvest be from a potable water source.

Guiding Principles for Manure and Municipal Biosolids

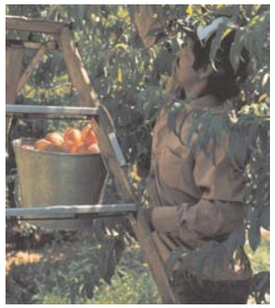
Properly composted manures or municipal biosolids are not a source of microbial pathogens on fresh produce.

- Become informed about proper compost management for pathogen reduction and document the method of pathogen elimination of applied manure.
- Document or obtain documentation about the specific compost management for each lot.
- Maximize the time between application of manure to production areas and harvest.
- If the use of multi-season drip irrigation is practiced, spreading of manure without incorporation into the soil requires careful attention to ensure that pathogen reduction practices have been met and documented.

Guiding Principles for Minimizing Animal Fecal Contamination

It is not possible, or may not be permissible, to eliminate all animal influences from production fields. However, steps to minimize their presence or activities should be determined.

- Domestic animals should be excluded from fields during the growing and harvesting season.
- Evaluate the need for bare soil buffers to adjacent land that may encourage high populations of reptiles, amphibians, rodents, birds or other potential sources of contamination.
- Minimize the presence of vector attractants (such as cull piles) within a production field.



Guiding Principles for Worker Health and Hygiene

There is no substitute for awareness, training, and constant reinforcement of the importance of personal hygiene and sanitation as critical to sustainable business and employment.

- Follow all OSHA and CAL OSHA requirements for sanitary facilities.
- Establish a training program including proper hand washing techniques and the importance of using toilet facilities.
- Establish and communicate a clear policy that will allow workers, who report or are observed to have symptoms of illness or diarrhea, to be reassigned to activities that do not involve food or food surface contact. In the absence of such a policy, it is probable that a worker will not report an illness to prevent loss of wages.
- Carefully inspect areas frequented by unsupervised workers (such as night irrigators) for signs that additional training is needed.
- Provide bandages or other protective coverings to workers with cuts or lesions on parts of the body that may make contact with fresh produce.
- If gloves are used, provide instruction on proper use to prevent pathogen transfer to fresh produce.
- Use caution when servicing portable toilets to prevent leakage into a field.
- Provide physical diversion and containment in the event of waste spillage. Have a plan for product isolation and destruction in the event of a spill.

Guiding Principles for Field and Harvest Sanitation

All surfaces and implements that touch fresh produce must be treated as food contact surfaces

- Clean all food contact surfaces and harvest containers or bins prior to use.
- Ensure that harvest contractors and crews are aware of microbial food safety risk reduction principles and adhere to established safe food practices.
- Develop and document a system of cleaning and sanitizing food contact surfaces.
- Minimize the opportunity for vectors to contaminate packing surfaces and materials.
- Minimize the access or attraction of vectors to harvest equipment kept in the field (such as no damaged fruit left on belts or grading tables).

Guiding Principles for Packing Facilities

Well -designed and operated centralized packing facilities and packing systems have the potential to contribute to the reduction of pathogen contamination. Lapses in facility or system management have the potential to amplify localized contamination, broadly re-distribute pathogens, or create opportunities for pathogen contamination within the facility.

- Design and maintain packing surfaces and equipment to minimize injury to produce and to maximize accessibility by cleaning or sanitizing crews.
- Establish routine cleaning and sanitizing programs for all food contact surfaces.
- Remove as much dirt as practicable from harvest containers, trailers, or gondolas between harvest uses. This should be done outside the packing facility and isolated from any water source used for postharvest handling.
- Clean pallets, containers, or bins before use.
- Establish and maintain a pest control program.
- Prevent birds or other vectors from contaminating packing equipment surfaces, packing areas, and storage areas.
- Store unformed or empty containers off the floor or bare soil surface and in a way that protects them from contamination.

Guiding Principles for Postharvest Water During Packing

The quality of postharvest water that contacts fresh produce during cleaning, grading, cooling, and application of surface treatments is widely recognized as the essential control point for fresh produce.

- Follow programs typical of Good Manufacturing Practices (GMP) to ensure that all water is of adequate quality throughout all packing operations from start-up to the last packed unit.
- Antimicrobial chemicals help minimize the potential for microbial contamination to be spread by packing operation water; levels of antimicrobial chemicals must be routinely monitored and recorded to ensure they are maintained at appropriate levels.
- Special attention to water quality is required for dump tank systems and re-circulated water.
- Keep air-cooling and chilling equipment clean and sanitary.
- Transport, store, and use ice under sanitary conditions.

Guiding Principles for Transportation

Limited control is possible beyond the shipping dock, but the consequences of cross-contamination during transportation and distribution will find a direct link back to the handler and grower.

- Inspect transportation vehicles for cleanliness, odors, obvious dirt and debris before loading. Insist on trailer or container clean-out before loading, if needed.
- Ensure that transporters, distributors and retailers maintain the integrity of the positive lot identification and traceback systems that are being used.

Guiding Principles for Storage and Distribution

Well-designed and operated wholesale distribution, load consolidation, and cross-docking facilities have the potential to maintain the integrity of a pathogen-free product. Lapses in facility sanitation or system management have the potential to amplify localized contamination, promote internalization of pathogens into products and broadly re-distribute pathogens.

Mixed storage and mixed load distribution has the potential to transfer contamination from one lot or product to a previously non-contaminated produce item, especially where pallet-stacking, ice injection, or top-icing is involved.

- Be aware of the potential for cross-contamination.
- Separate dry and wet product and place water-repellant shipping barriers between mixed loads.

Guiding Principles for Fresh-cut or Value-added Processing

Well -designed and operated processing facilities have the potential to contribute to the reduction of pathogen contamination. Lapses in facility or system management have the potential to amplify localized contamination, broadly re-distribute pathogens to the edible flesh, or contaminate pathogen-free melons from within the facility during handling.

Washing, in combination with a disinfectant treatment, will reduce but not eliminate microbial contamination. Greater microbial reductions are achieved on smooth, waxy produce than on rough textured or porous products.

For produce such as cantaloupe, mechanical removal by brush-washing in combination with an approved antimicrobial agent is essential prior to cutting and rind removal.

Proper temperature management (cold chain control) is important for quality and safety management but cannot be relied upon, alone, to provide sufficient consumer protection from potential food borne illness.

- Use only good quality fruit, free from open wounds or defects that may have allowed bacteria to become internalized. Avoid fruit that have visible sunken areas or areas of mold or decay.
- Product flow should be linear; incoming product should not cross paths or be stored next to cleaned or processed product. Ideally, packing areas should be physically separated from receiving and processing areas.
- Worker traffic flow and activities should not move between packing and receiving.
- Develop specific worker training programs for fruit handling and processing to prevent bare-hand or gloved-hand contact of non-cleaned fruit rind and cut fruit flesh, in sequence, by the same individual.
- Antimicrobial chemicals help minimize the potential for microbial contamination to be spread by process water; levels of antimicrobial chemicals must be routinely monitored and recorded to ensure they are maintained at appropriate levels.
- Special attention to water quality is required for common wash tank or flume systems and any re-circulated water.