



## FOOD TECHNOLOGY FACT SHEET

Adding Value to OKLAHOMA

405-744-6071 • [www.fapc.biz](http://www.fapc.biz) • [fapc@okstate.edu](mailto:fapc@okstate.edu)

# Developing a Food Safety Plan for Your Fresh Produce Operation

**William McGlynn**

FAPC Horticultural Products Processing Specialist

**Lynn Brandenberger**

Horticulture Food Crops Extension and Research Specialist

### The Oklahoma Cooperative Extension Service Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; home economics; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of Cooperative Extension are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and based on factual information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

### Introduction

The safety of fresh fruits and vegetables for direct consumption is an important issue for both consumers and producers. During the past few decades, consumption of fresh produce has increased substantially as people have learned more about the health benefits of a diet rich in fresh fruits and vegetables. Along with the increased consumption of fresh produce, there has been an increase in foodborne disease outbreaks associated with fresh produce. Both consumers and producers suffer adversely when fresh produce related outbreaks occur. Consumers suffer serious health risks, and the produce industry suffers from a loss in consumer confidence and trust and the resultant loss in sales. Aside from losses in human productivity and potential caused by illness and even death, an outbreak can result in the loss of millions of dollars from lost sales and lawsuits.

### GAPs

Good Agricultural Practices (GAPs) are an important concept for producers of fresh fruits and vegetables to understand in order to assure the microbial safety of produce that is grown in their operation. GAPs involve many things, but essentially they are practices used during planning, production, harvest and after harvest to guard the safety of fresh produce. However, there is not a one-size-fits-all plan for food safety. GAPs must be uniquely tailored to crops and management practices for each farm. Basically, we need to focus on reducing the risk of contaminating fresh produce. It is not possible at this time to completely eliminate food safety risks;

in fact, the Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables<sup>1</sup> states “current technologies cannot eliminate all potential food safety hazards associated with fresh produce that will be eaten raw.” Times during which producers should be vigilant to reduce and control food safety risks include prior to planting, during the planning stage, during production, and during and after harvest. Before planting, growers should complete a grower risk assessment. Cornell University has a great publication to help with this titled “Food Safety Begins on the Farm – A Grower Self Assessment of Food Safety Risks”<sup>2</sup>. The document includes 24 sections that provide GAPs and checklists for everything from worker hygiene to petting zoos. Working through the assessment will help producers in developing a food safety plan for their operation.

### GMPs

Good Manufacturing Practices (GMPs) pick up where GAPs leave off. GMPs cover issues such as sanitary design of the packing shed itself and any produce-handling equipment or produce contact surfaces, packing shed pest control, packing shed sanitation, worker health and hygiene monitoring, and temperature control for produce that requires refrigeration. Sanitizing washes or dips, which rely on chlorine or other sanitizers to kill harmful microbes, also may be part of a GMP program. The overall goal of a GMP program is to minimize and control the risks of contamination that occur after harvest and during packing and includes many of the same principles that are applied as part of a GAPs program.

Oklahoma State University, in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, gender, age, religion, disability, or status as a veteran in any of its policies, practices or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 74 cents per copy. 0716

It is important to note an on-farm packing shed is not normally considered a food processing facility. This means that an on-farm packing shed is generally exempt from state and federal licensing and inspection requirements that apply specifically to food processing facilities. Sometimes, however, packing sheds will perform certain operations that will cause them to be regarded as a food processing facility by state and federal authorities. Specifically, any process that alters the natural state of a raw agricultural product may be construed as food processing. Generally, this would include operations such as peeling, shelling, cutting and sometimes re-packaging harvested produce into retail packs. Be aware these sorts of activities will likely change the regulatory status of an on-farm produce handling facility.

## Five Step Plan to Developing a Farm Food Safety Plan

### Step 1: Address pre-plant issues

- *Land history and site selection.* Prevention should begin with proper site selection. A proper land history record will include the entire relevant history of a site's use, including past crops, applications of pesticides or other chemicals, human or animal waste applications, etc. If the site's history includes equipment and/or chemical storage, animal confinement or other possible avenues of contamination, this information is relevant as well. The goal of a land history survey is to determine whether or not the soil has potential for causing crop contamination or has potential for crop damage from previous land use. Proper site selection involves assessing the risks for both pre-planting and post-planting contamination. Therefore, property surrounding the site should be checked to evaluate the chances that contaminants may enter the field from dust, runoff or animals. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation site selection worksheet.
- *Water.* Water for irrigation should be tested annually or more often for fecal coliforms (2.2 fecal coliforms per 100 ml is the EPA limit for non-drinking (non-potable) uses. Overhead irrigation water should be treated if fecal coliforms exceed this limit. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation worksheet for irrigation and spray water.

- *Wildlife and domestic animals.* Animals have serious potential for contaminating crops with feces. Scout the field for game trails and adjacent areas for the potential of harboring wildlife or domestic animals that could enter the field. If concern exists, you will need to develop a plan to reduce these risks. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation site selection worksheet.
- *Crop selection.* Different crops vary in their potential for being contaminated. Root and leafy crops have a much greater potential for contamination than crops that flower and fruit (i.e. tomato, tree fruits, brambles, snapbeans), grain or forage crops. Be aware of this as part of creating a safety plan and making decisions about site selection, water use, etc.
- *Other potential risks.* These might include contamination by pets, workers, visitors, field machinery, etc. Be aware of these risks and address them in a plan as necessary.

### Step 2: Address production issues

- *Irrigation / spray water.* Water is the most likely way of spreading contamination to fresh produce. During production pay special attention to monitoring irrigation water safety and using only drinkable (potable) water for crop sprays. Irrigating using drip or furrow irrigation is less likely to spread contamination to produce than overhead or flood irrigation. Water supplies should be tested at least annually and more often if well sites have experienced flooding or are uncapped. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation worksheet for irrigation and spray water.
- *Field worker hygiene.* Field worker hygiene is an important part of keeping fresh produce safe during production. Provide not only convenient, clean restroom and hand washing facilities, but also training to ensure that workers understand the importance of personal hygiene for keeping fresh produce safe to eat. Worker training materials and videos are available at Cornell University's National GAPs training Web site<sup>3</sup>. See fact sheet FAPC-167 Developing a Food Safety Plan

## Glossary of food safety terms\*

**Case.** The illness of one person associated with food.

**Clean or cleaning.** Removing soils and residues from surfaces by washing and scrubbing with soap or detergent and rinsing with clean water.

**Cold chain.** The maintenance of proper cooling temperatures throughout the food system (farm to fork) for fruits and vegetables to assure product safety and quality.

**Contaminate.** To transfer impurities or harmful microorganisms to food surfaces or water.

**Cull.** To pick out and destroy fruits or vegetables that are not up to quality or food safety standards due to blemishes, wounds, bruises, being misshapen or due to obvious contamination, e.g. with fecal matter.

**Foodborne illness.** An illness transmitted to people through food products resulting from ingesting foods that contain pathogens, their toxins or poisonous chemicals.

**Good agricultural practices (GAPs).** The basic environmental and operational conditions necessary for the production of safe, wholesome fruits and vegetables.

**Good manufacturing practices (GMPs).** The basic environmental and operational conditions necessary for the packing and processing of safe, wholesome fruits and vegetables.

**Hepatitis A virus.** Virus that causes a disease of the liver. It can be found in water that has been contaminated with raw sewage. Infected workers also can transmit hepatitis A.

**Imbibe.** To absorb moisture into a fruit, leaf tissue or other plant part.

**Microorganism or microbe.** Bacteria, molds, viruses, etc. so small they cannot be seen without a microscope. Some are beneficial, others spoil food, and some cause sickness and even death.

**Nonpotable water.** Water that is not safe to drink. Sources may be polluted by sewage, animal waste or chemical runoff from agricultural fields and urban landscapes.

**Outbreak from foodborne sources.** An incident in which two or more persons experience a similar illness after eating a common food and epidemiological analysis implicates the common food as the source of the illness.

**Pathogen.** Any microorganism that causes disease in humans.

**pH (Acidity/Alkalinity).** pH is the measure of acidity or alkalinity in a food product, expressed on a 0 to 14 scale with 7 being neutral, below 7 being acidic, above 7 being alkaline.

**Potable water.** Clean water that is safe to drink.

**Produce contact surfaces.** Surfaces of equipment with which fruits and vegetables come into contact.

**Rinsing.** Removal of residues, soil, grease, soap and detergents from surfaces by flushing with potable water.

**Sanitizer.** A chemical compound designed to kill microorganisms. Two commonly used sanitizers are chlorine bleach and quaternary ammonium compounds ("quats"). Sanitizer solutions are made by mixing a measured amount of the sanitizer with potable water according to label directions.

**Sanitizing.** Process to kill microorganisms. Includes rinsing, soaking, spraying or wiping the surface with a sanitizing solution. Surfaces should be properly washed and rinsed before they are sanitized.

**Total titratable chlorine.** The amount of chlorine determined by an acidified starch iodide and thiosulfate titration.

**Traceback.** Ability to trace a fruit or vegetable back to its field of origin.

**Washing.** Removing all solid soil or food residues from surfaces by scrubbing with soap or detergent.

*\*Glossary of food safety terms was taken from "Food Safety Begins on the Farm, A Grower's Guide, Good Agricultural Practices for Fresh Fruits and Vegetables" by the Cooperative State Research, Education and Extension Service, USDA and FDA.*

**Table 2. Common types of sanitizers and their characteristics.**

Sanitizer	Uses	Recommended concentrations	Contact time required	Advantages	Disadvantages
Chlorine-based	Produce wash water, equipment, & facilities	* ≤200 ppm without rinsing * ≤ 2,000 ppm with potable H <sub>2</sub> O rinse	1 to 5 minutes at 200 ppm	*Inexpensive *Available *Wide range of effectiveness	*Corrosive *Irritating fumes *Rapid loss of effectiveness
Quaternary ammonia "Quats"	Hands, facilities, food contact-surfaces, & equipment	* ≤200 ppm without rinsing *200-500 ppm with potable H <sub>2</sub> O rinse	≥1 minute	*Non-corrosive *Relatively non-irritating	*Good residual activity/stability *Less effective than others for control of E. coli
Iodophors "Iodine-based"	Facilities, food contact-surfaces, & equipment	*12.5-25 ppm without rinsing * >25 ppm with potable H <sub>2</sub> O rinse	≥1 minute	*Effective at: -low conc. -wide pH range -hard water *Non-irritating *Good penetration *Prevents biofilm formation *Good residual	*Expensive *May stain *Not a cleaner

for Your Fresh Produce Operation worksheet on worker training.

- *Fertilizer use.* Fertilizers vary in their potential to harbor microbial contaminants. Synthetic fertilizers have low potential for contamination while uncomposted and improperly composted manure has a high potential. Sidedressing during the growing season should use only well-composted manure or synthetic fertilizers. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation worksheet on fertilizer, compost and manure application.
- *Animal control.* Controlling access to the field will reduce the risk of contamination from people, livestock and wildlife. Exclude livestock, including pets and poultry, from the field with fencing or other means. Develop and implement a plan to manage wildlife access through appropriate methods. Workers and visitors access to the field should be controlled to limit access when wet field conditions exist. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation worksheets on animal control.

**Step 3: Address harvest issues**

- *Harvest worker hygiene.* Worker and U-Pick customer health and hygiene is a key component of the overall program to guard the safety of fresh produce during harvest. Workers will need to be trained in their responsibilities, and well maintained restroom facilities will need to be provided to allow them to carry these out. U-Pick customers will need convenient, well-maintained restroom facilities and signage to encourage them to follow good sanitary practices. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation worksheets for worker training and field and packing shed restroom cleaning and service.
- *Harvest equipment cleaning.* Harvest equipment must be maintained in a clean and sanitary condition. Pressure wash, rinse and sanitize all harvest bins, harvest aids and machinery. Cover washed and sanitized bins to prevent recontamination by wildlife. Maintain harvest equipment to minimize abrasion and wounding of fresh produce. See fact sheet FAPC-167 Developing a Food Safety Plan

for Your Fresh Produce Operation worksheets for worker training, field harvest / processing / packing / cleaning and the field and packing shed restroom cleaning and service log.

- *Avoid damaging produce.* Wounds or other damage provides an entry point for harmful microorganisms into fresh produce, and once inside, these microorganisms cannot be removed or killed by washing or sanitizing agents. Therefore, is it very important to avoid damaging produce before or after harvest. Be aware of equipment or contact surfaces that may cut, bruise or compress produce. Minimize operations that transfer produce from one container to another. Also, beware of damage to produce that may occur during harvest from improper use of equipment, untrimmed fingernails and so on.
- *Holding / transport equipment cleaning.* Transportation and holding equipment including bins, trailers, trucks, etc. should be checked on at least a daily basis and maintained in a clean and sanitary condition. Follow a checklist for inspection of vehicles that will be carrying fresh produce. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation worksheets for truck checklist and processing, packing line, facility cleaning.
- *Fresh produce cleaning.* Safe produce handling should include removing soil from produce as it may be a source of contamination. Clean equipment and produce before it enters the packing shed. Consider using a sanitizing agent as part of the cleaning process. Damaged or diseased produce should be culled in the field to avoid contamination. Note culled produce should be transported to a remote cull pile as soon as possible in order to avoid attracting pests or creating a reservoir for both human and plant pathogens.

**Step 4: Post harvest issues to address**

- *Cooling or wash water sanitation.* Water used for cooling or washing must be clean and drinkable (potable). If water is being sanitized by adding chlorine, then the strength of the chlorine solution must be checked at least daily, more often if required or whenever a fresh tank of water is prepared. See fact sheet FAPC-167 Developing a

Food Safety Plan for Your Fresh Produce operation washing / cooling / sanitizing water treatment worksheet.

- *Cooling water temperatures.* If a water tank is being used to hydrocool fresh produce, ensure the cooling water is no more than 10°F cooler than the incoming produce to minimize the risk that produce will absorb or imbibe water during cooling.
- *Strength of sanitizing washes.* Table 1 gives basic recommendations for chlorine-based sanitizing solutions that can be used to help ensure the safety of fresh produce. If a sanitizing wash is appropriate, the strength of the chlorine solution should be monitored at least once a day, more often if required or whenever a fresh tank of solution is prepared. Be aware that the strength of the chlorine will dissipate during time and the more soil is present on the produce, the more quickly the strength of a chlorine-based sanitizing solution will be lost. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce operation washing / cooling / sanitizing water treatment worksheet.
- *Packing shed cleaning.* The packing shed should receive a general cleanup to remove dirt, debris and culled produce at least once a day. Produce-handling equipment and any surface that comes in contact with produce should be cleaned and sanitized daily. Bathrooms, sinks, waste receptacles and floor drains also should be cleaned and sanitized daily, or more often if needed. Frequent inspections of the facility should be performed throughout the day to ensure sanitary conditions are maintained. Cold rooms should be cleaned and sanitized once a month or as operations allow. Rodent and insect traps and other pest control aids should be inspected and renewed as necessary – generally at least once a month. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation worksheets on field, packing shed restroom cleaning and service, processing packing line facility cleaning and pest / rodent control. Note high-pressure hoses are not recommended for general cleaning when produce is being packed because high-pressure water sprays can create aerosols that may trans-

port harmful microorganisms over long distances. A 200 PPM chlorine solution (1 tbs household bleach / gallon water) makes an effective sanitizing solution when applied with a contact time of at least two minutes. Prior cleaning is important to ensure the sanitizer is effective. Note surfaces sanitized with 200 PPM or stronger chlorine should be rinsed with clean water or allowed to air dry before coming into contact with produce. See Table 2 for further information on sanitizer options and recommendations.

- *Proper storage of packed produce.* Hold and store produce away from possible hazards, e.g. cleaning agents, pesticides, etc. Hold and store produce off the floor, away from walls and in such a way as to avoid damage. If the produce is stored in a cold room, be sure to monitor and record temperatures. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation cooler temperature worksheet.
- *Transportation of packed produce.* Trucks used to transport produce should be cleaned and sanitized prior to loading. If trucks are not used exclusively to transport produce, then be aware of what other items may have been previously transported and clean accordingly. If refrigerated transportation is being employed, consider using temperature monitoring systems to help ensure proper refrigeration temperatures are being maintained during shipping. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation truck checklist worksheet.

**Step 5: Address important record keeping issues**

- *Create and maintain records for all employee trainings.* See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation worker training log.
- *Create and maintain records of facility cleaning and sanitizing.* See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation processing / packing line / facility cleaning and field / packing shed restroom cleaning and service worksheets.
- *Create and maintain records of produce sanitizing, if applicable.* See fact sheet FAPC-167

Developing a Food Safety Plan for Your Fresh Produce Operation washing / cooling / sanitizing water treatment worksheet.

- *Develop a traceback system for your farm that will allow you to trace produce to the field that it was harvested from, including harvest date.* See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation produce tracing and recall traceback worksheets.
- *Consider developing a HACCP-like program for your farm (Hazard Analysis Critical Control Points).* This system will identify where contamination problems are likely to occur (Critical Control Points) and will provide ways to address these potential hazards.

- *Records of all produce leaving your farm should be maintained to assist you in traceback and in any other problems that may occur.* Remember if you don't record it, you didn't do it. See fact sheet FAPC-167 Developing a Food Safety Plan for Your Fresh Produce Operation produce tracing worksheet.

<sup>1</sup>Available from the FDA Web site at [www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/default.htm](http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/default.htm)

<sup>2</sup>Available from Cornell University's National GAPs training Web site at [www.gaps.cornell.edu/index.html](http://www.gaps.cornell.edu/index.html)

<sup>3</sup>Available from Cornell University's National GAPs training Web site at [www.gaps.cornell.edu/education-almaterials.html](http://www.gaps.cornell.edu/education-almaterials.html)

<b>Table 1. Strength of chlorine sanitizing wash recommended for various types of produce.</b>		
<b>Type of Produce</b>	<b>Recommended PPM Chlorine</b>	<b>Bleach/gallon of water<sup>1</sup></b>
Apples, pears, squash, cucumbers	65 PPM	1 tsp/gal
Leafy greens, peaches, peppers, tomatoes, asparagus, broccoli, carrots	130 PPM	2 tsp/gal
Melons, citrus, root crops	400 PPM <sup>2</sup>	2 tblsp/gal
Berries (strawberries, blueberries, blackberries, raspberries, etc.)	No washing	N/A
<sup>1</sup> Bleach/gallon of water based on using household bleach containing no fragrances or thickeners with a base concentration of 5.25% sodium hypochlorite.		
<sup>2</sup> Sanitizing wash should be followed by a potable water rinse.		