



UNIVERSITY OF
FLORIDA

FSHN0211

EXTENSION

Institute of Food and Agricultural Sciences

Fresh Produce Handling, Sanitation, and Safety Measures: Citrus¹

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Introduction

Maintaining good sanitation throughout handling is important. Human pathogens can be transmitted by direct contact (infected employees or animals) or through contaminated water or soil. Once a fruit is infested, pathogens are difficult or impossible to remove by any means other than cooking. Only thorough cooking (or other similar treatment, such as pasteurization) will reliably neutralize any pathogens infesting a fruit. However, such a treatment is not possible for fresh produce. An extra benefit of good sanitation to growers and shippers is that sanitation also reduces infection by plant pathogens and reduces decay during shipping and storage. It is vitally important that growers, and in turn their employees, understand just how critical any food poisoning outbreak could be to their livelihoods.

This document focuses on how to best reduce contamination possibilities to maintain a wholesome product, hopefully thus avoiding any food poisoning outbreaks. These broad areas will be covered:

- 1.0 Preharvest
- 2.0 Harvest
- 3.0 Personnel Cleanliness
- 4.0 Packing, Storage, and Transport
- 5.0 Unpacking and Display
- 6.0 Documentation and Record-Keeping

1.0 Preharvest

1.1 Irrigation water

Application method affects water quality requirements. Irrigation water usually does not contact fresh citrus and is not generally a major concern.

1. This document is FSHN0211, one of a series of the Food Science and Human Nutrition Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Publication: October 2002. Please visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.
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- In the rare case that overhead irrigation is used, water should ideally be tested to be free of coliforms since it will contact the fruit.
- For microjet, flood or seepage irrigation systems, water is less likely to contact fruit, especially on skirted trees. Thus, less emphasis is placed on water quality.
- Pumps and irrigation stations must also be kept free of contaminant sources such as scum build-up, animals, human/animal waste products, etc. If a pump is contaminated, all the water going through the pump and anything that water is sprayed on can become contaminated as well.

Allow a drying period before harvest. The longer the period between harvest and the last irrigation, the less likely any contaminating pathogens have survived.

1.2 Frost protection water cleanliness

Management of within- or above- canopy frost protection water is similar to that of irrigation if water makes direct fruit contact. Ideally, water should be of drinking water quality (potable) if it comes in contact with fruit.

1.3 Water used for pesticide mixing

Since pesticide water does come in direct contact with fruit, this water should be from a potable source. Fresh produce has been contaminated by tainted water mixed with pesticides.

- In any case where water quality is a concern, numerous factors can affect the microbial load. However, contamination potential can be minimized by following a few general rules:
 - Give preference to groundwater sources: they have a lesser chance of becoming contaminated by direct or indirect contact with humans or animals.
 - Surface water quality may change from day to day and is subject to animal contamination.

- Municipal water is, of course, potable.

Check with your lab to determine the best local water-testing schedule to keep, as necessary.

1.4 Animal exclusion

Most human pathogens are carried by other animals (fowl; reptiles; amphibians; mammals such as dogs, cats, deer, raccoons, etc). Exclusion of as many animals as possible from the field and picking operations will decrease the likelihood of contamination.

- This is a recurring theme from the field and irrigation, to harvest to shipping and storage. Animals can bring contaminants into contact with fruit at any stage, from farm to fork!

Any animal materials (waste, carcasses, etc.) should be removed immediately from the field if possible (and practical).

- Carcasses should be incinerated or buried.
- Fruit near these areas should not be harvested.

Workers that come in contact with live animals, animal carcasses or animal waste materials should wash their hands before they continue working.

- This includes fruit that may have been the victim of a recent bird fly-by. If a worker touches this fruit, the material can get on their hands and be spread to any other fruit they contact. If human pathogens were present in the waste material, all of the fruit are now potentially contaminated and an outbreak may occur.

1.5 Human Hygiene

If pickers are in the grove for more than 3 hours, OSHA requires that there be 1 portable toilet per 20 employees.

- These must be moved with the crews to be kept within 1/4 mile of them at all times.
- They must never be emptied in the grove or near surface water sources!

- Appropriate hand-washing facilities are also needed in conjunction with portable toilets.

1.6 Soil Contaminants

Animal manure applied as fertilizer must be composted unless it is incorporated into the soil not less than 90 days before harvest for crops (such as citrus fruit) that are not in contact with the soil. Fully composted manure should still be handled in such a way that contact between the material and the edible portion of the crop is avoided.

- 'Fully composted' means organic matter has been maintained between 131°F and 170°F for 3 days using an in-vessel or static aerated pile system, or for 15 days using a windrow composting system, during which period the material must be turned a minimum of five times (Natl. Organic Prog. Final Rule Sec. 205.203).

Biosolids (human waste) are strictly regulated (Code of Federal Regulations, title 40 part 503).

- They are best to be avoided outright.
- They can NOT be used in organic operations.

Be aware of land use near the grove.

Establishment of citrus groves near animal operations or waste handling facilities should be avoided.

The key is that manures should never have an opportunity to come into contact with fruit. Fruit that fall to the ground, called drops or windfalls, should only be harvested when the finished product receives a heat kill step such as pasteurization. **Drops should never be harvested for fresh market.**

2.0 Harvest

2.1 Pesticide residuals

Pesticides labels are for safety of product, employees and the environment. It is critical that they be followed.

Remember these points not only when applying any pesticide, but especially regarding harvest and re-entry:

- Only apply those treatments specifically labeled for the commodity

- Apply pesticides only when and as directed by the label

- Do NOT harvest until the label-designated time

- Always remember: ***“The Label is the Law!”***

2.2 Animal exclusion

Animals can easily transmit pathogens.

Minimizing animal contact in fields and packing facilities reduces the risk of contamination.

- No domesticated animals should be in the grove at harvest.
- No children should be allowed in the grove during harvesting operations.
- Practice animal and insect control in and around harvesting equipment storage areas.

2.3 Bag, bin and tub cleanliness/sanitation

Washing containers and harvest bags before each use and storing them such that they remain clean reduces the chances of contamination.

- Contact with dirt (e.g. sand) in the container can cause microscopic wounds where microorganisms can enter.
- Stored containers can easily become contaminated by rodents, insects, and other animal life. Regularly inspect containers for cleanliness and avoid contact with the ground whenever possible.
- Store empty containers separately from:
 - those already filled with fruit
 - any potential chemical contaminants (e.g. chemical storage areas)
 - any other sites for potential contamination (near waste receptacles, animal infested areas, etc.)

Soil on rungs of harvest ladders may vector transfer of pathogens. Avoiding hand contact with rungs helps limit opportunities for soil and soil-borne microorganisms to transfer to fruit. Painting rungs red and informing crews to not touch red portions of the ladder can assist in this.

3.0 Personnel Cleanliness

3.1 Recognizing symptoms of food-borne human diseases

It is important to recognize symptoms of illness to better keep sick workers away from the commodity. Some symptoms may include: fever, diarrhea, vomiting, sore throat or jaundice (yellow skin and eyes).

3.2 Exclusion of ill workers

Employees displaying symptoms of illness should either have appropriate measures put in place to protect the fruit from exposure (gloves, a mask to prevent sneezing contamination, etc.) or, if this is not feasible, be disallowed from coming in contact with fruit or any equipment that will contact fruit.

- Workers that have recently had enteric (intestinal) disease should, if allowed to work at all, be utilized in a non-fruit handling capacity.
- Sending sick employees home is, unfortunately, the best method of dealing with this.

3.3 Disease transmission: cross contamination

Probably the #1 source of food-borne illness is unsanitary worker conditions.

Most of the diseases transmitted via fresh produce occur as part of the “fecal-oral pathway.”

- This is the movement of human pathogens from an infected individual's waste to the ingested material of a healthy person.
- Most commonly, this occurs by the infected individual handling food without properly washing their hands.
- **Employee hygiene, including hand-washing and proper facility use, is an important step in breaking the infection cycle.**

Open wounds can also contain pathogens. Use of a sealed covering (rubber or latex gloves; just a bandage is not sufficient) is the only way to contain them. The best method of reducing contamination from open sores or wounds is by removing affected employee(s) from situations where they may come in contact with fruit, directly or indirectly.

3.4 Well-stocked, well-lit hand-washing stations and restroom facilities

Employees can only maintain good hygiene if the proper facilities are available to them.

Restrooms in packinghouses must have appropriate hand-washing facilities.

- Includes a place workers may remove aprons, smocks and/or gloves and store them *outside* of the restroom.
- Hand washing stations located outside of restrooms can aid supervisors in ensuring employee hygiene.

To be effective, hand-washing facilities must be well stocked with:

- A fresh water source (*not re-circulated water*)
- Soap
- A non-reusable hand drying system (disposable towels, air dryer, etc.)
- A sanitizing solution may also be used *in conjunction with, but not to replace*, proper hand washing.

4.0 Packing, Storage and Transport

4.1 Packinghouse and degreening room cleanliness

The environment in a degreening room (warm temperature and high humidity) is ideal for the proliferation of microorganisms. Because of this, degreening rooms should be cleaned with each season, or more frequently if they become overly soiled. Points of water accumulation should also be avoided, such as not storing fruit under water dripping from a ceiling.

Animal Exclusion – As in the preharvest and harvest procedures, practice animal and insect control in and around packing facilities.

Cleaning and sanitation of packingline equipment is critical. Just one source of pathogen introduction, at any point, can potentially inoculate all fruit that pass through the line.

- Cleaning – physically removing debris, biofilm build-up, and any other residuals on the line. This is done with detergent and physical labor (such as scrubbing or a pressure washer, etc.).
- Sanitation – using sanitizers of various types to kill microbes on clean surfaces. *Sanitation is most effective after a surface has been cleaned.* This is true of packing lines, hands, bins and anything else that may become soiled.
- Many steps can easily be overlooked during cleaning. Here are some key points to remember:
 - Remove debris accumulation from all surfaces.
 - Clean all surfaces that fruit or employees may contact, including bench/table tops, drains, walls, cooler coils, ceilings, etc., as appropriate.
 - Clean using a Top-to-Bottom method to avoid re-soiling already cleaned surfaces.
 - Closed-in spaces can be fumigated for sanitation.
 - Never put fruit that have fallen from the line back into circulation.
 - Have waste receptacles available for employee use and regularly empty and clean them.
 - Properly store all equipment after the workday ends.

Regular cleaning greatly reduces opportunities for pathogen build-up and inoculation to occur.

4.2 Dump/Soak tanks:

If using a fungicide truck drench, bin drench, or dump tank system, sanitizers (e.g. chlorine) or sanitation steps (e.g. heating) used to reduce fruit pathogens may help control human pathogens as well.

- Wherever possible, drain and clean dump-tanks daily.
- Be sure to rinse out any cleaning solutions before re-filling the tank (e.g. residuals from quaternary ammonium solutions may produce toxic fumes when contacted by chlorinated water). Such cleaning solutions are often not registered for direct fruit contact and may injure the peel.
- Be sure to follow the label on all chemical products.
 - Fruit should not be allowed to sit in a dump tank for extended periods of time, such as during employee breaks.

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4.3 Culling – The removal of rotten fruit

Evidence from other fruits suggests that human pathogens more readily proliferate in injured and decaying fruit. This adds to the importance of removing injured or decaying fruit as soon as possible to help reduce the potential for cross-contamination.

- Cull removal is important to avoid the spread of decay pathogens or harbored human pathogens from infested fruit to sound fruit.
 - Keep packed fruit separate from unsorted bins and away from other potential contamination sources.

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4.4 Temperature

Human pathogens tend to grow slowly or not at all below ~45°F (7°C). This is therefore the normal target for cooling systems. However, depending on the cultivar, growing region, maturity, fruit treatment (such as waxing or temperature conditioning), etc., storage below 45°F may not be possible due to potential development of chilling injury. In such

cases, citrus fruit should be stored at the lowest safe temperature.

Cooler system coil maintenance and sanitation is also important (any pathogens growing in the air handlers can be blown onto the stored commodity, possibly infesting your entire store of product!).

4.5 Vehicle cleanliness

Be sure truck trailers are clean. If a trailer previously was used to haul raw meat, for example, there is a great potential for contamination by several different human pathogens. Trailers should be cleaned appropriately if there are traces of odors or visible signs of foreign matter.

- If you cannot clean a suspect trailer, at least record its condition for later reference, if necessary.

4.6 Reefer maintenance

Reefer maintenance should be completed and recorded to avoid inappropriate shipping temperatures. Use of a data logger to track temperature and cooler functionality/accuracy during transit is also desirable. Reefer coils and air handling ducts should also be cleaned and sanitized on a regular basis.

4.7 Product loading and receiver unloading

After being precooled, to maintain the cold chain fruit should never leave an appropriately refrigerated atmosphere, even during handling at loading/unloading docks. This maintains overall fruit quality in an environment that will minimize pathogen growth.

4.8 Impact of personnel, handling, loading and unloading on product safety

Use the same GAPs and sanitary guidelines as for field and packinghouse operations in terms of employee handling, loading and unloading for product safety. This is particularly important if handlers have any direct contact with the fruit.

5.0 Unpacking and Display

5.1 Product quality issues

Even at the consumer level, the cold chain must be maintained. Removal of bruised and decaying fruit while setting up and rotating displays reduces chances for human pathogen proliferation as well.

Use sanitation procedures in the back room and display area as outlined previously for earlier handling steps to avoid cross contamination between different foods or contamination by workers.

5.2 Limit consumer handling

Consumer packs may be preferable to bulk displays because they avoid possible contamination of fruit by consumers while selecting produce.

6.0 Documentation and Record-Keeping

Keeping records is important to document adherence to GAPs and help identify potential problem areas.

- Keeping records helps alleviate legal responsibilities in a trace-back situation.
- Keep track of microbial test results, reefer and storage room temperature levels, any and all cleaning and maintenance activities, etc.
- History has shown that, in a trace-back situation following an outbreak, responsibility is often pinned on those with the least (or worst) kept records.
- Self-check lists are available from several commercial auditing companies.