



Food Safety for Farmers Markets: from Planting to Delivery

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Producers are Food Handlers.

Locally grown fresh produce is valued by many for its superior taste and health-promoting qualities. However, fresh produce can become contaminated with harmful organisms spread by water, animals, or people. By paying attention to basic principles, growers can greatly reduce the risk of their produce becoming contaminated by common food-borne pathogens, such as *E. coli*, *Salmonella*, *Listeria*, and others. Following the guidelines in this publication will help you lower the risk that YOUR produce becomes contaminated and makes someone ill.

Each step of food production presents unique risks for contamination:

1. Growing the Crop
2. Harvesting and Storage
3. Cleaning or Washing Product
4. Packaging, Storing and Transporting
5. At the Market

Worker health and hygiene are also critical to maintaining food safety throughout the whole production process.

Keeping your Produce Safe: Growing the Crop

Each grower should evaluate their farm, starting before the crops are growing in the field, and considering water source, risk from flooding, and proper use of manure. Additionally, growers should restrict access by pets or wild animals as much as feasible, scout for contamination, and clean and sanitize equipment before use to avoid cross-contamination. Each of these risks will be detailed further below.

Water Source

Clean water is crucial to safe food production, especially for crops that will be consumed raw. Once contaminated water is applied to a field, *E. coli* and other harmful organisms can persist for over six months in the soil, and can enter plants through roots, flowers, or be protected in crevices of the plant tissue.

Municipal Water

Municipal water is generally the safest water source since it is potable (safe to drink) and adheres to strict chemical



and microbiological standards. Chlorine and fluoride from municipal sources are at concentrations low enough not to interfere with plant growth.

The South Dakota Drinking Water Program, part of the Department of Agriculture and Natural Resources (DANR), develops and enforces the South Dakota Drinking Water regulations that apply to public water systems in the state. Drinking water contaminants, compliance reports, and violation history of public water sources across South Dakota can be viewed at the DANR's drinking water webpage. Additionally, a Proof of Safety may be furnished through a water bill or by request. To contact the DANR Drinking Water program visit their website at danr.sd.gov/OfficeOfWater/DrinkingWater/SourceWaterProtection or call (605) 773-3754.

Well Water

If well water is being used, have it tested for microbial contamination at the beginning of the season before the first irrigation, and every three months thereafter. Information on state testing can be found at danr.sd.gov/OfficeOfWater/DrinkingWater/PrivateWellSampling.aspx. The test of choice is for *E. coli* specifically, rather than for generic coliform bacteria counts. Wells can become contaminated by flooding or heavy rains, or if located close to a cesspool, septic system, livestock agricultural site, manure storage area or drainage field. Properly maintaining a well includes conducting annual wellhead inspections to check the condition of the well covering, casing and cap to be sure it is in good condition. There should not be any cracks or entry points for potential contaminants. In addition to regularly scheduled testing, wells need to be tested when at greater risk of contamination, for example, after a flood or unusually heavy rains, or anytime changes occur in the water quality such as cloudiness or grit. These may indicate surface water is contaminating the well. If you notice these changes, have the water tested again.

Surface Water

Surface water, such as from rivers or creeks, lakes, or ponds, can become contaminated by farm animals, wildlife, runoff during storms, flooding, leaking or overflowing septic systems, and manure piles. Therefore, surface water should only be used as a last resort, and it should be tested at planting, peak use, and prior to harvest of each crop type. Minimize the contact of surface water with the edible portion of plants by using drip, furrow, or subsurface irrigation. A drip irrigation system is preferred, ideally with a subsurface application, or drip underneath plastic mulch. Overhead spray methods have high risk for contaminating the harvested portion of the produce.

Surface water should NEVER be used for post-harvest washing.

Flooding

Floodwater may deposit contaminants such as chemicals and pathogenic microorganisms onto both the soil and plants. Because of the wide variety of possible contaminants and their erratic occurrence, testing is generally not a viable option. One needs to assume that contamination may have occurred and manage the affected area accordingly. *(Pooled water, which is the simple accumulation of water within a field following a rainfall, is not considered flooding.)* The FDA has developed specific guidelines for fields affected by flooding; for links to a fact sheet based on this guidance, visit SDSU Extension and search "Food Safety from Production to the Farmers Market."

Manure Use

Fresh manure should NEVER be applied to fields where crops that will be eaten raw are planted. Manure may be composted following organic standards, or aged at least six months before application; nine months to a year is preferable. Keep manure piles away from produce fields, and if feasible, cover them to avoid transfer to the field by wind or insects. Avoid tracking manure into a field on field equipment or footwear, from the time of planting on through harvest.

Compost Tea

Compost teas must be made only from potable water and properly composted materials (contact SDSU Extension for further details). It must be produced in sanitized containers and not have materials such as molasses, sugar, or other bacterial growth-enhancing substances added.

Animal Intrusion and Feces

When feasible, wildlife and domesticated animals should be kept out of fields with fencing or other means. However, complete exclusion is rarely possible, especially with smaller animals or birds. Field workers should be trained to watch for animal tracks, and especially feces, and these should be marked so that affected produce is not harvested within a reasonable “splash” zone.

Harvest

Before harvesting, the field should be scouted and any contaminated (feces or other hazards) areas should be clearly delineated, marked, and not harvested. All workers should be instructed in and follow all guidelines in the Health and Hygiene section. Do not put harvested produce on the ground once it is harvested as this may expose it to pathogens on the ground surface. (The exception is produce that will be cooked, or used ornamentally, such as pumpkins and gourds). Never place bruised or damaged produce in the same container as good produce, as bruising/cracking/etc. can allow pathogens to grow quickly and spread to intact produce.

Produce Containers

Only single-use containers (such as cardboard boxes), or containers that can be cleaned and sanitized should be used. Wooden containers are discouraged as they are difficult to clean and sanitize, and splinters or fasteners may drop into the produce unnoticed. If used, line with a food-grade plastic bag. Trash bags may contain chemicals that can leach into the produce, so only food-grade plastics should be used. Do not reuse cardboard boxes, even if they are waxed.

Avoid placing harvest containers directly on the ground (use a cart, clean tarp, or second container), as this can introduce contaminated soil into processing areas.

Designate containers to be used solely for harvest of produce and others for trash or culls or other uses.

Never reuse chemical containers for produce storage, as any chemical residuals may leach into the produce. Store containers away from animals, off the ground/floor, and cover when not in use to decrease risk of bird droppings or dust contamination.

Cleaning and sanitizing containers and equipment is an important part of reducing the risk that your produce pick up pathogens. See sidebar on **Cleaning and sanitizing equipment.**

Managing Produce Quality

Produce with damaged surfaces (cracks, cuts, rots, bruises, etc.) should be culled, because these injured areas can serve as entry points for harmful microorganisms. These microorganisms can then be transferred from the damaged produce to high quality produce. To reduce cross-contamination it is best to pick the blemished produce separately. These culled produce items should not be piled



Workers should watch for contaminants in the field, such as these deer feces.



Wooden boxes are attractive, but nearly impossible to clean adequately. If used, always line with food-grade plastic. Photo by Jen Theodore, Unsplash.



A wheelbarrow is used to keep harvest containers off the ground. Photo by Kelly Neil, Unsplash

within the field, because this can attract insects and animals that carry harmful microorganisms, a situation that has been implicated in the incidence of deadly disease outbreaks. Instead, dispose of or compost culled produce in a location that is not near the growing, processing, or storage areas.

Produce quality is the number one reason many customers come to a farmers market. This is another reason why defective produce should be culled and disposed of, not sold. Undamaged lower quality produce, such as misshaped items, should at the very least be separated and sold separately. However, marketing lower quality produce can have a negative influence on the customers' perception of all your produce. Rather than market your lower quality produce a better option may be using undamaged but misshaped produce in a processed product or donating it to the local food bank.

Harvest Records

Keep harvest records by recording the following information: what type and quantity of produce was harvested; field location; who harvested which produce; and the date of harvest. These records can be valuable for recording the productivity of the fields throughout the season as well as tracking of produce that may be implicated in a foodborne illness. A tracking system for marking containers of harvested produce with a code that contains this information can also prove helpful. For more information, visit the Cornell website at gaps.cornell.edu and search for "traceability".

Cleaning or Washing Produce

Cleaning

After harvest, if necessary, excess field dirt and plant debris can often be removed from many types of produce by gentle scrubbing with a dry brush, or wiped with a soft cloth. Be sure to clean the brushes frequently and use a tarp or container to catch the dirt so it does not contaminate the processing area. It is recommended to use this method of dry brushing when possible, rather than washing, before packing or marketing fresh fruits and vegetables, as this decreases contamination risks (see below). However, very muddy produce or produce that cannot withstand brushing (such as berries or tomatoes) may require washing with water.

Understanding Contamination Risks during washing

In some instances, washing produce may be required. In determining whether and what method to use, the following should be considered:

- Can I use a pass-over spray instead of submersing the produce in the water?
- What is the possibility that the produce was contaminated and that the contamination could be spread in the wash water?
- Should this specific produce be washed and how should it be washed?
- Is the water source a public treated and tested source, or a private well that requires sampling sent to a state health lab for testing?
- What temperature should the water be?
- Should I use a sanitizing solution?

Cleaning and Sanitizing Equipment

All food contact surfaces should be cleaned and sanitized before and after use. Use detergent and sanitizer labelled for use with food surfaces. Pressure wash, rinse and sanitize all crop containers, tools, and work surfaces prior to each day's harvest. Sanitizers should be used on surfaces only after thorough cleaning with abrasion to remove organic materials such as dirt or plant materials. To effectively clean and sanitize containers and equipment:

1. Remove all visible dirt/debris using a medium (not high) pressure spray.
2. Apply detergent and scrub the surface thoroughly. Watch for crevices where dirt may be hidden.
3. Rinse thoroughly, since soap and organic matter can bind with the sanitizing solution, decreasing its effectiveness in killing germs. Rinse water must be potable.
4. Apply appropriate sanitizer according to label directions.
5. Rinse or let air dry, according to the label.

See producesafetyalliance.cornell.edu/sites/producesafetyalliance.cornell.edu/files/shared/documents/Cleaning-vs-Sanitizing.pdf for more information.

Washing with water must be done carefully, as it has the potential to cause contamination. Water can infiltrate to the inside of the fruit or vegetable through the following process: When produce is placed in a container of water that is colder than the produce, it causes the air in the cells of the fruit to contract. This contraction draws water into the fruit or vegetable through pores, channels, or bruises. Any bacteria or parasite that was on the surface of the fruit or in the water can be drawn into the produce with the water, causing the produce to become internally contaminated.

The following procedures provide tips and best management practices for handling specific produce items without causing contamination or lowering the quality or appearance of the produce.

Tomatoes

Grow bush varieties or trellis or stake tomatoes to keep fruit off the ground. When possible they should not be harvested when the fruit is wet; if necessary, air-dry the tomatoes before packing. A soft clean cloth can be used to wipe off dust as needed. Store above 55°F to avoid chill damage.

Melons and Cantaloupe

Melons have several qualities that make them more susceptible to contamination than other fruits and vegetables including:

- Warm weather growing conditions are favorable for the growth of human pathogens such as *E. coli*, Salmonella, and Listeria.
- Direct contact with the soil and heavy rains may increase the risk for contamination.
- Netted rinds provide a good area for human pathogens to survive, and the removal of pathogens is more difficult than with smooth surfaced produce.
- When harvested, scarring occurs around the stem. This can serve as a route for infiltration of pathogens.
- Watermelons and less mature cantaloupe are sensitive to injury when chilled, therefore increasing the likelihood of storing at ambient temperatures that encourage the growth of microorganisms.

All of these reasons contribute to the fact that melons have repeatedly been associated with foodborne illnesses.

To reduce the risk of contamination of melons:

1. Follow all recommended food safety field practices. Watch for field incursions by wild or domestic animals, and do not harvest any melons within five feet of any animal droppings. Flag contaminated areas to help harvesters avoid them. Train all field staff in food safety hazards and procedures, including handwashing.
2. Clean all containers, shipping, and storage surfaces. Do not transport in an unwashed truck bed. Clean padding can be used to reduce bruising and abrasions.
3. If necessary, clean with soft dry brushes. Provide customers with safe handling and preparations instructions for cantaloupe, for example, extension.sdstate.edu/cantaloupe-pick-it-try-it-preserve-it.

Leafy Greens

When possible, harvest early in the morning as the produce will be cooler and better hydrated. To maintain quality, spray with a light mist when harvested to reduce the loss of water. This must be a potable water source and the method used for spraying must not introduce additional contaminants.

When greens and other crops are harvested, they need to be cooled quickly to maintain quality and safety. Leafy greens are high-risk crops for food safety, in part because of their proximity to the soil. Consider the following precautions to minimize the contamination of leafy greens and other produce:

- Avoid cross-contamination from other types of produce by dedicating containers to be used only for leafy greens.
- One wash option is to use a pass-thru system, where the greens are spread on clean mesh trays that allow quick drainage and are sprayed with fresh clean water rather than submerging the produce in a water bath. It may be necessary to stir or turn the greens several times so that all surfaces are cleaned.
- If submerging the produce or using a recirculating water system for spraying, to prevent infiltration (see above) the water should be no more than 10°F colder than the produce. Even potable water may become

contaminated from the produce if the produce is submerged in the water rather than simply sprayed.

- You should use several washings after harvesting leafy greens and other crops. Start with water that is slightly cooler (less than 10°F) than the produce and progressively use colder water in subsequent washings. This will help cool the leafy greens and safely maintain quality. Studies at the University of Vermont have found that using three consecutive rinsing (with fresh water each time) or a single rinse with sanitizer drastically reduced the amount of E. coli remaining on lettuce leaves.

Immediately after cooling with water, place leafy greens in a cooler to maintain a temperature of 32 to 36°F. Be diligent about keeping the cooler clean! Do not store leafy greens in a closed container with other fruits or vegetables that produce ethylene gas, such as apples, tomatoes, bananas, mangos, onions, and pears. Ethylene gas can cause browning and an off taste in lettuce and other greens. High humidity (90 to 95%) needs to be maintained to minimize wilting. Avoid contact with standing water, which can serve as a source of cross-contamination. Clean, moist (not soggy) paper towels can provide sufficient moisture if coolers are not equipped with humidifiers.

Scallions or Green Onions

Bunching is usually done in the field with the outer leaves stripped off and the roots clipped. Always use cleaned and sanitized knives and other equipment. Filled boxes should be moved to the processing shed within two or three hours of being harvested. The scallions are run through a washing and cooling process that uses 33 to 35°F chlorinated water bath or spray. The wash water should contain 75 to 100 ppm free chlorine (1 ½ teaspoon 5.35% Chlorine Bleach to 1 gallon of water) to reduce postharvest decay.

Packaging and Storage

All packaging should be made of food contact grade materials. Products that are not food grade may contain toxic compounds that could leach out of the packaging materials and into the produce. Empty packages such as boxes and plastic bags should be stored in an enclosed area to protect from insects, rodents, dust, dirt, and other potential sources of contamination.

A variety of facility designs are available for cold storage, ranging from commercial walk-in coolers to farm-adapted designs, or even refrigerated truck trailers. Most coolers are designed to keep cool produce cool, not take off the “field heat” from the produce. Forced-air designs help remove “field heat”, but there must be good air circulation to avoid hot spots that can lead to product deterioration. When possible, harvest early in the day when the produce is still relatively cool.

Remember that crops differ in their tolerance to cold temperatures; for example, tomatoes, cucumbers and peppers can be damaged by temperatures under 45° to 50°F. Carrots, broccoli, cauliflower, cucumbers, lettuce and acorn squash are sensitive to the ethylene that can be emitted by fruit such as apples, so store them separately.

Transportation

Whenever transporting produce from the field or to the market, ensure that the vehicle is clean and sanitary. If you use a general-purpose farm pickup for transporting fresh produce, thoroughly wash, rinse, and sanitize the bed each trip. This is especially important if live animals or objects of dubious sanitation have been transported previously. During transportation, packaging, and at the market provide shade for the produce with a clean plastic tarp or other cover to reduce heat buildup and sun scalding.



For more information on farm food safety, see:

- foodsafetyclearinghouse.org/
- producesafetyalliance.cornell.edu
- extension.umn.edu/safety/growing-safe-food
or contact SDSU Extension.

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