Good Agricultural Practices (GAPs) can improve produce quality and safety and protect your business. Producers also use standard cleaning and sanitizing practices to reduce sources of microbial contamination on their products.

This publication focuses on the best cleaning and sanitizing practices for food products and food contact surfaces. It includes a resource list plus a sample form for monitoring sanitizer effectiveness and a sample cleaning schedule.

- Washing, rinsing, and sanitizing may appear to increase costs, but they enhance product quality and offer these benefits:
- Soil and particles that can cause decay or spoilage are removed.
- Microorganisms that cause foodborne illness can be eliminated or reduced to a safe level.
- Clean produce is more visually appealing to customers.
- Product shelf life increases when spoilage organisms are removed.

IOWA STATE UNIVERSITY
Extension and Outreach

On-farm Food Safety:
Cleaning and Sanitizing Guide

Using good sanitation practices during production, harvesting, and packaging can help reduce the risk of microbial contamination of fresh produce. Soil, fertilizers, harvesting equipment, water, workers, or animals such as livestock, pets, and pests can be sources of harmful microorganisms that cause foodborne illness. Surfaces that come in contact with produce must be washed, rinsed, and sanitized regularly. Employees need to understand and use appropriate food handling practices.

Food Contact Surfaces

Any surface that comes in contact with food, either directly or indirectly, is a food contact surface. Examples include preparation tables, spinners, food bags, and cartons for transporting produce. Food contact surfaces should be smooth and nonporous to allow for easy and effective cleaning. Rough surfaces, such as wood, can harbor dirt and microorganisms. Stainless steel tables and counters are commonly used in foodservice and processing facilities due to durability and ease of cleaning.

Other surfaces that can come into contact with product include containers for harvesting and transportation, tables in packing areas, bags and other packaging materials, conveyors, processing equipment, employee aprons, outerwear, and gloves. Hands also may come into contact with the food. For more information about food handling practices, see "On-farm Food Safety: Food Handling Guide" (PM 1974b).

Cleaning

Cleaning means removing soil and residues. For product (fruits and vegetables) the cleaning steps vary with how dirty the product is, and the tenderness and perishable nature of the food. For example, root vegetables often require initial rinsing, scrubbing, followed by one or two additional rinses to remove soil residue, while only rinsing can be safely used on leafy green vegetables. Fruits and vegetables that grow well above the ground may be brushed or wiped when soil and other residue are minimal. Other tender or highly perishable products such as strawberries or raspberries should not be washed with water until just prior to use, as should all fruits and vegetables. When water is used for cleaning, it should be potable (safe to drink). New research shows that for certain vegetables, such as tomatoes, bacteria can be pulled into openings if the wash water temperature is colder than that of the produce item.

Cleaning of food contact surfaces means removing soil and residues. This involves a three-step process of rinsing away surface debris, washing and scrubbing with soap or detergent, followed by rinsing with clean potable water. Rinsing surfaces thoroughly is important so that any detergent residue is removed.

Under certain conditions, microorganisms (bacteria, yeasts, and molds) can form invisible films (biofilms) on surfaces. Biofilms can be difficult to remove and usually require cleaners (for physical removal) as well as sanitizers (for killing of biofilm microbes.)

Sanitizing

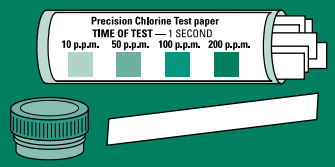
Sanitizing is the process of treating a food contact surface with a sanitizing solution that will kill most microorganisms or reduce them to a non-harmful level. For sanitizers to be effective, surfaces must first be cleaned, because soil and soap residues can make the sanitizing solution less effective.

- ***Sanitizing*** is a process that reduces the contamination level of a product or food contact surface surface by 99.999 (5-log reduction) percent in 30 seconds.

- ***Sanitizer*** is a chemical compound designed to kill microorganisms. Chlorine bleach (sodium hypochlorite concentrations 5.25 to 6.5 % in liquid form) and quaternary ammonium compounds (quats) are commonly used sanitizers for food contact surfaces. Chlorine and hydrogen peroxide, at proper concentrations, can be used

PM 1974C Revised March 2013

Chlorine Test Kit



How to use test strips

- Make sure the test strip is appropriate for the type of sanitizer.
- Prepare the sanitizing solution.
- Dip a strip into the solution.
- Compare the color the strip changed to with the guide on the outside of the package to determine the solution strength.
- Record sanitizer concentration

Cleaning tips

- Have tools, supplies, and waste receptacles easily available for employee use.
- Make sure waste receptacles are regularly emptied and cleaned.
- Have a place to properly store all equipment at the end of the day.
- Encourage employees to share ideas related to cleaning and sanitizing.
- Look for potential problems when walking through your operation.
- Evaluate all cleaning and processing equipment and utensils daily.
- Conduct a visual inspection to make sure surfaces are in good condition and cleaned and sanitized regularly.
- Establish a cleaning and sanitizing schedule for equipment and food contact surfaces.

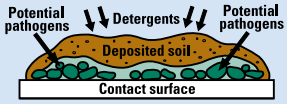
for food products. However, excessive concentrations may damage product tissues and/or lead to toxic levels. Producers should check with regulators in their areas regarding approved agents. It is recommended only registered formulas be used.

- ***Sanitizing solution*** is the mixture of a specific amount of a sanitizer with potable water, according to the directions given by the manufacturer to create the proper concentration.

Sanitizing solutions gradually lose effectiveness over time. As the solution is continually exposed to air or organic materials, reactions cause some of the chemical to dissipate. The best way to check whether a sanitizing solution is effective is to use a test strip. Sanitizing solutions should be made and checked at least daily. They also should be recorded. (See sidebar to left for an example of chlorine test strips).

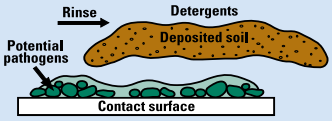
How the cleaning and sanitizing process works

1



Washing helps loosen soils and other organic material from the surface. **Detergent and scrubbing** also helps break the adhesion of microorganisms to the surface.

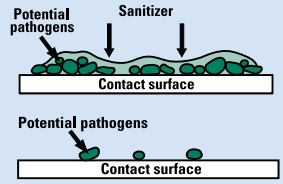
2



Rinsing removes loosened soil and detergent from the surface. This step is important because organic material and detergent can bind up sanitizer making it less effective.

3

4



Applying the **sanitizer** to clean surfaces actually provides a "kill" step for reducing the number of microorganisms. The surface is not completely free of microorganisms, but the number is greatly reduced, and if done correctly, will result in a safer product without quality damage.

Choosing a Sanitizer

Producers should select a sanitizer based on these characteristics: safety for workers and the environment, stability, water quality and pH, and non-corrosiveness. Several types of sanitizers are available for products and/or food contact surfaces: chlorine (50 – 200 parts per million or ppm), quaternary ammonium or quats (see label for recommended concentrations), hydrogen peroxide, and new generation food-grade vegetable washes. (See sidebar on page 3).

New generation food-grade vegetable washes, such as PRO-SAN®LC, sanitize fresh produce and produce contact surfaces and are biodegradable. Chlorine and hydrogen peroxide are commonly used for products because they are readily available and cost effective. For a complete list of approved sanitizers for products and food contact surfaces, check with state and federal regulatory agencies.

Sanitizers may have multiple uses. For example, chlorine can be used on fresh produce or on food contact surfaces, depending on the concentration. Room temperature water should be used to minimize chlorine loss in the solution. The proportion of sanitizer to water must be accurate to make sure the solution will be effective and avoid damage to products and consumers. A common recipe for a chlorine based sanitizing solution is 1 tablespoon household bleach (**non-scented**) per 1 gallon room temperature water. This will result in a solution of 100 ppm. A range of 50 – 100 ppm is recommended for food contact surfaces. This solution is applied as a fine spray in the final step of the cleaning process and should not be wiped or rinsed off. Surfaces should be allowed to air dry. We recommend 100 – 200 ppm chlorine solution for products. Mixing up to 2 tablespoons per gallon of water (200 ppm solution) can be used because organic materials, like soil, will break down effectiveness of the chlorine quickly. Removing as much soil as possible from the product prior to washing, and changing chlorinated wash water frequently is recommended. A final rinse with potable water can be used on the produce but is not necessary.

Chlorine bleach can be purchased in several concentrations of the active ingredient, sodium hypochlorite. A typical concentration is 6%. (Check

the label because super concentrations of bleach are being introduced in the market). Keep in mind that water quality (such as pH and amount of minerals) can significantly impact the effectiveness of both detergents and sanitizers. Chlorine is most effective in killing microorganisms at pH bewteen 6.0 and 7.5. Check pH and concentrations with test strips regularly and record on a monitoring form (see example).

Hydrogen peroxide is another common sanitizer for products. This may be purchased in a shelf-stable form at appropriate concentrations (e.g., Tsunami®), which lessens the risk of an on farm accident when mixing solutions. Or, producers can prepare solutions themselves using 1% to 5% of hydrogen peroxide; generally a 3% solution is used. Caution should be taken during this process to protect worker from harm.

Use a test strip to achieve the recommended concentration for the specific product. (The concentration for hydrogen peroxide is usually listed in percents while other sanitizer concentrations are shown by ppm). Research has shown that adding 1/2 cup acid such as acetic, citric, or lactic acid to 1 gallon of hydrogen peroxide solution can significantly improve the effectiveness of the solution. Tsunami® contains acetic acid.

New Generation Washes

New generation food-grade fruit and vegetable washes, such as PRO-SAN® LC (Liquid Concentrate) and FreshRinse® sanitize fresh produce and produce contact surfaces. These new, acid-based washes minimize overall microbial numbers and inactivate common bacterial pathogens such as *Salmonella spp.* Most consist of only biodegradable components so washes are environmentally friendly. Unlike chlorine, hydrogen peroxide, ozone, and peroxyacetic acid, these new generation washes are non-oxidizing and are less reactive with the fresh produce.

Several sanitizers are approved by the USDA National Organic Program: chlorine, ozone (which requires ozone generating equipment), and peroxyacetic acid (Tsunami®); acetic acid (although the vinegar must be from an organic source); and hydrogen peroxide. These New Generation washes are Generally Recognized as Safe (GRAS).

Sample Chemical Sanitizer Monitoring Form

Date	Initials	Test Strip Result	Use
8/15/10	DH	Chlorine 50 ppm—OK	Surfaces
8/15/10	DH	Chlorine 200 ppm—OK	Product

Directions:
1. Complete this form daily.
2. Record date, your initials, and test strip result.
3. Indicate whether the test strip turned the appropriate color to meet the sanitizer concentration standard. The result is either "OK" or "CHANGED." If the solution is changed, indicate corrective action on the form.
4. If the sanitizer solution is redone, log the new concentration on the form.

The key to effective cleaning and sanitizing is making these practices part of normal operations. Equipment should be cleaned from top to bottom to avoid re-soiling already cleaned surfaces. In general, four questions need to be answered.

1. **What** should be cleaned?
2. **How** should each piece of equipment or food contact surface be cleaned and sanitized?
3. **When** should equipment be cleaned? Daily, weekly, as needed?
4. **Who** is responsible? Is a specific person or a position responsible for each cleaning task? Who will check to make sure the list is done according to schedule?

Many steps can be easily overlooked during cleaning. Action items in the schedule should be incorporated into regular duties of workers. Workers should initial the form to document that the task is completed. Regular cleaning reduces the build-up of microorganisms.

Sample Cleaning Schedule

Area	Cleaning Frequency	Cleaning and Sanitizing Method	Person Responsible
1. Preparation table in packaging area	Beginning of the day and between packaging different products	1-Remove debris accumulation using clean cloth and soapy water. 2-Rinse table top with clean water. 3-Sanitize with clean cloth and chlorine sanitizer solution of 50 ppm.	Bill / 1-5-11
2.			
3.			
4.			
5.			

Visit www.iowahaccp.iastate.edu for sample cleaning procedures, schedules, and monitoring forms

Summary

Cleaning and sanitizing are part of an overall food safety plan to provide the safest and best quality fresh fruits, vegetables, greens, and herbs to customers. Checklists, standard procedures, and schedules are typically the best ways to communicate information to employees and document that proper cleaning and sanitizing practices are followed.

References and Resources

More information about general produce food safety, GAPs, and food safety plans is available at the following websites.

Local Foods: From Farm to Foodservice, Hotel, Restaurant, and Institution Management Extension, Iowa State University
http://www.iastatelocalfoods.org

Environmental Protection Agency
http://www.epa.gov

Good Agricultural Practices Project, Cornell University
http://www.gaps.cornell.edu

Good Agricultural Practices, New England Extension Food Safety Consortium
http://www.hort.uconn.edu/IPM/foodsafety/index.htm

Guidelines for the use of chlorine bleach as a sanitizer in food processing operations, (Publication FAPC#116), W. McGlynn, Oklahoma State University Cooperative Extension
http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-963/FAPC-116web.pdf

Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables, Center for Food Safety and Applied Nutrition (CFSAN), U.S. Food and Drug Administration
http://www.fda.gov/downloads/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/UCM169112.pdf

HACCP: Hazard Analysis Critical Control Point Information Center, Iowa State University Extension
http://www.iowahaccp.iastate.edu/

Postharvest handling of fruits and vegetables
2000. Janet Bachmann and Richard Earles. National Sustainable Agriculture Information Service - ATTRA. Available at www.attra.ncat.org/attra-pub/postharvest.html

Vegetable Research and Information Center, University of California Cooperative Extension
http://vric.ucdavis.edu

Organic Materials Review Institute
Founded in 1997, the Organic Materials Review Institute (OMRI) provides organic certifiers, growers, manufacturers, and suppliers an independent review of products intended for use in certified organic production, handling, and processing.
http://www.omri.org/

National Good Agricultural Practices Network
The National Good Agricultural Practices Network is based at Cornell University.
http://www.gaps.cornell.edu/index.html

USDA BioPreferred Catalog may be found at the following website:
http://www.biopreferred.gov/bioPreferredCatalog/faces/jsp/catalogLanding.jsp
This electronic catalog may be used to find and compare information on BioPreferred products and companies that supply them.

Institution Management; and Aubrey Mendonca, Food Science and Human Nutrition. Revised by Lester Wilson, Food Science and Human Nutrition; Catherine Strohbehn, Hotel, Restaurant and Institution Management; Paul Domoto, Horticulture; Margaret Smith, Value Added Agriculture; Byron Brehm-Stecher and Aubrey Mendonca, Food Science and Human Nutrition. Reviewed by Angela Shaw, Food Science and Human Nutrition.

LEOPOLD CENTER

This publication is supported by a grant from the Leopold Center for Sustainable Agriculture.