

# Wash Water Chlorine Disinfection: Best Practices to Ensure On-farm Food Safety



Washing fresh produce with **potable water** treated with a sanitizing agent can reduce microorganisms and pathogens that may be on the surface of the produce.

These potential problems include post-harvest rot and decay microorganisms such as spoilage bacteria and yeast, Botrytis, penicillium and mucor as well as foodborne pathogens such as E.coli, cyclospora, Listeria, and salmonella .

Chlorine can be used in wash water for **apples, nectarines, plums, cherries, grapes (or muscadines), leafy greens, peppers, tomatoes, peas, melons, cabbage, green onions, cucumbers and zucchini squash.**

Do not wash or disinfect berries such as strawberries, blueberries, blackberries or raspberries. While peaches and pears can be washed and sanitized, care must be taken because these fruits easily bruise and the washing process can damage the fruit and increase the chances of post-harvest decay.

## How to wash and disinfect fresh produce with chlorine?

**Step 1. Remove soil and other types of organic debris from the surface of the produce before treating the product.** Soil and organic debris reduce the effectiveness of chlorine. Before treating the produce with chlorine, rinse with potable water.

**Step 2. Measure the temperature of your wash water.** Wash water should be cool but not cold. Chlorine is most effective when water temperatures are between 55 and 120 degrees Fahrenheit. When washing tomatoes, peppers, melons or other produce with large stem scars the water **temperature should be at least 50 degrees Fahrenheit higher than interior temperature of the produce.** If the water is colder than the produce, plant and human pathogens can be sucked into the fruit. Chlorine cannot kill pathogens that are inside the fruit. Holding produce with large stem scars for four to five hours before washing will allow

the scars to heal and reduce the potential for pathogen intake.

**Step 3. Measure and mix chlorine into potable water.** The amount of chlorine you add to your water depends on the concentration you want to achieve, and the desired concentration is crop dependent. If you are using household chlorine bleach (5.25-6.25 percent hypochlorite), avoid the “splashless” or scented formulations. The following table provides the ranges of chlorine concentrations that should be used to disinfect different types of produce. A minimum contact time of 1 minute is recommended to ensure the pathogens are killed.

Produce Type	Chlorine Strength *(parts per million)
Apples	100-150
Cabbage, leafy greens	100-150
Cucumbers	100-150
Green onions	100-150
Lemons	40-75
Oranges	100-200
Peaches, nectarines, plums	75-150
Pears	200-300
Peas (pod type)	50-100
Peppers, potatoes (Irish), tomatoes	200-350
Sweet potatoes	100-150

(Source: Suslow, T. V., 2000)

Assuming a concentration of 5.25 percent hypochlorite in chlorine bleach, use the following volumes to achieve a concentration of 65-400 parts per million chlorine.

Amount of Chlorine Bleach per Gallon of Water	Approximate Chlorine Strength (parts per million)
1 teaspoon (5 milliliters)	65
1 tablespoon (15 milliliters)	200
1 fluid ounce (30 milliliters)	400

The chlorine concentration can be verified using chlorine test strips or kits. These strips estimate the amount of chlorine (hypochlorite and hypochlorous acid) in water treated with chlorine bleach. Test strips or kits can be purchased at most pool supply stores, online or at other stores that sell food-use sanitizers.

**Step 4. Monitor the pH, ORP and sanitizer levels.**

**pH:** Chlorine is most effective when the pH of water is maintained between 6 and 7. Always check the pH of your water before adding the chlorine. Add a dry acid such as sodium bisulfate to lower the pH. White vinegar also can be used to lower the pH. Add soda ash (sodium carbonate and/or washing soda) to increase the pH. Chlorine solutions with pH values lower than 5 will form toxic chlorine gas and are corrosive. Solutions with a pH greater than 8 quickly lose their effectiveness for microbial inhibition and also are corrosive.

**Oxidative Reduction Potential, or ORP:**

Oxidative reduction potential is a measure of a sanitizer's ability to effectively kill or inhibit pathogens. Measuring the oxidative reduction potential after the sanitizer has been added provides a rapid assessment of the disinfection potential of the sanitizing solution. Sanitizing solutions with an ORP value of **650-750 mV** will kill surface spoilage bacteria, E. coli and salmonella within a few seconds. Spoilage yeast, botrytis, penicillium, mucor and phytophthora are killed after 1 or 2 minutes. Devices to measure ORP (ORP meters) can be purchased at most pool supply stores, online or at other stores that sell food-use sanitizers.

**Chlorine levels:** Chlorine levels (measured in parts per million, or ppm) can be measured using the test strips or kits described above. The oxidative reduction potential, however, is a more informative measurement. It is important to note that a high level of chlorine, as measured by a test strip, does not necessarily indicate a high level of effectiveness.

**Step 5. Rinse produce** with clean potable water

following the chlorine treatment. After rinsing, air dry produce in a clean and closed area. If drying by hand, single-use paper towels should be used.

**Step 6. Change the water frequently.** The wash water should be changed when it becomes dirty and when a new crop is added. The wastewater can be poured down a drain or onto an area that does not contain edible crops.

**Step 7. Record all your practices.** Maintain a log sheet with the date, time, chlorine concentration (ppm), pH, ORP (mV), water temperature and contact times (amount of time produce was exposed to the chlorine solution). All records must be kept on the farm and be readily available within 24 hours of a formal request by an auditor or inspector.

**CAUTIONS**

1. Always read and follow label instructions.
2. Always measure and mix chlorine or other sanitizers in a well-ventilated area.
3. Keep chlorine and other sanitizers away from children and pets.
4. Keep chlorine or other sanitizers in tightly closed and labeled containers. Do not expose sanitizers to heat or direct sunlight.

**Other Sanitizers for Use on Fresh Produce:**

Additional products are registered for fresh produce sanitation including chlorine dioxide, hydrogen peroxide or dioxide, hydrogen peroxide plus peroxyacetic acid or peroxyacetic acid. For more information on these sanitizers and instructions on how to use them for produce sanitation, consult the Southeastern U.S. Vegetable Crop Handbook ([www.thepacker.com/grower/2015-southeastern-us-vegetable-crop-handbook](http://www.thepacker.com/grower/2015-southeastern-us-vegetable-crop-handbook)).



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