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Fact Sheet

Fact Sheet 715

Cleaning and Sanitizing Fresh Produce and Fresh Produce Handling Equipment, Utensils and Sales Areas

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Cleaning of produce should precede sanitizing treatments. Cleaning and rinsing or washing in water removes dirt, soil and plant juices (sap) and reduces the size (number) of the microbial population. However, washing alone does not eliminate microbes. Produce items that contain adhering soil can be washed in cool water containing a USDA-approved mild alkali cleaning agent such as sodium carbonate, sodium bicarbonate, sodium sesquicarbonate, sodium metasilicate or trisodium phosphate. After cleaning, the produce is ready to be sanitized. Sanitizing agents destroy the vegetative cells of micro-organisms but sanitizing agents do not sterilize the produce because some microbial spores, and even a few vegetative cells, generally survive treatment with sanitizing agents.

Chlorine is the most widely used sanitizer in food processing operations in the United States. It has a number of advantages including:

- it kills micro-organisms rather rapidly;
- it is safe for consumers and is acceptable to the FDA;
- it has no adverse effects on the food;
- it is economical;
- it is readily soluble in water; and
- it is easily tested for solution concentration.

Chlorine sanitizers have several major disadvantages, however. They cause corrosion of iron, steel, stainless steel, copper, brass, aluminum and tin; they also do not have much residual kill power and are inactivated by organic matter.

The important factors affecting the germicidal properties of chlorine include the acidity (pH) of the solution, the concentration of the chlorine in the solution and the temperature of the solution. The most economical and readily available form of chlorine is bleach. Bleach is a solution of sodium hypochlorite (NaOCl) in water. Most common laundry bleach is 5.25 percent sodium hypochlorite in water. Sodium hypochlorite solutions are very alkaline with a pH in excess of 9 or

10. At this high pH, bleach is not a very effective germicide. The pH of the bleach solution must be reduced to between 6 and 7 in order to form hypochlorous acid (HOCl). Hypochlorous acid is the most germicidal form of chlorine in aqueous media. Thus, when bleach is added to water to form a germicidal sanitizing solution it is necessary to adjust its pH to between 6 and 7. The easiest and most economical way to do this is to add distilled vinegar to the bleach-water mixture. When enough vinegar is added to adjust the pH of the solution to between 4 and 5, the solution is mostly hypochlorous acid (HOCl), and its germicidal power is greatest. However, when the solution pH is between 4 and 5 it is very corrosive to metals. Thus, using the bleach solution at a pH between 6 and 7 gives satisfactory germicidal power and the solution is not excessively corrosive. When the pH of a bleach solution is decreased to below 4.0, deadly chlorine gas is formed. Thus, it is important to only reduce the pH of the bleach solution to not less than about 6.

The FDA allows the use of sodium hypochlorite as a sanitizing agent for the food contact surfaces of food processing equipment in concentrations up to 0.02 percent or 200 parts per million (ppm). Chapter 21 Part 178.1010 of the Code of Federal Regulations (CFR) is the regulation that is valid for this use. At sodium hypochlorite concentrations of 200 ppm or less there is no requirement to rinse the treated surface with water prior to use. The U.S. FDA regulation 21 CFR 173.315 allows for fruits and vegetables to be washed in water containing up to 0.2 percent sodium hypochlorite.

Vegetative cells of microbes are easily killed by chlorine, but bacterial and mold spores are not. Thus, surfaces treated with chlorinated water may contain high numbers of surviving spores. The resistance of spores to the killing power of chlorine is due to their relatively impervious and dense outer coating or wall. The chlorine must first penetrate the wall of the spore to reach and oxidize the internal protoplasm. Not only must the chlorine penetrate the spore wall to attack and kill the spore; microbes exude a complex polysaccharide-based material when they are present on a surface—this sticky, protective coating forms a complex film around the cells and spores which is called a "biofilm." Thus, the chlorine in a sanitizing solution must get past the protective biofilm coating in order to attack the cells and spores embedded in it. In order to assist the chlorine to penetrate the spore wall and to gain access to microscopic "nooks and crannies" on treated surfaces a surfactant—a "wetting agent"—can be added to the bleach-vinegar-water sanitizing solution. Sodium lauryl sulfate is a good FDA-approved surfactant for this purpose as is a material referred to as Polysorbate 60 or TWEEN 60. This is a wetting agent that has the chemical name polyoxyethylene sorbitan monostearate and it is also FDA-approved for food use. Proper cleaning and sanitation acts to prevent or retard the formation of biofilms.

In order to make an effective chlorine-based sanitizing agent for use on fresh produce, food handling equipment, utensils, machinery, preparation and display room walls, ceilings and floors, the following formulation can be used when added to 1 gallon of water:

1 teaspoon of common household bleach

2 teaspoons of 40 grain white (distilled) vinegar

½ to 1 teaspoon of an approved wetting agent

This mixture contains 50 ppm of hypochlorous acid at a pH between 6 and

7. In order to make a 50 gallon solution multiply the amount of each ingredient by 50. In order to make a 50 gallon solution of 100 ppm of hypochlorous acid use[1] :

(50) (2) (1 teaspoon of bleach) =
100 teaspoons of bleach ≅
1 pint of bleach

(50) (2) (2 teaspoons of vinegar) =
200 teaspoons of vinegar ≅
2.1 pints of vinegar

(50) (½ teaspoon of wetting agent) =
25 teaspoons of wetting agent ≅
¼ pint of wetting agent

Effective destruction of microbes on produce can be achieved by placing the produce in a "pool" of the above sanitizing agent. The longer the produce remains in the sanitizing solution the greater will be the total number of microbes destroyed. It is important to remember that produce should be chilled after harvest and should be kept cool or cold until prepared for consumption. Therefore, the sanitizing bleach treatment should be done using cool water that is about 20°F warmer than the produce temperature. Dwell time of the produce in the sanitizing solution can range from between 1 to 5 minutes or 10 minutes. After the produce is removed from the sanitizing solution it can be allowed to drain for several minutes prior to packaging it or placing it on display. The residual chlorine on the produce does not impart a "bad" flavor and is dissipated in a few hours. The vinegar (acetic acid) concentration in the sanitizing solution is so weak that no "acid" or vinegar taste is apparent on the produce.

One word of caution is necessary. Some produce items should never be wetted after harvest because exposure to moisture accelerates mold growth. In particular, berry fruit such as raspberries, blackberries and even strawberries should not be sanitized using an aqueous medium.

Cleaning of equipment, utensils, walls, ceilings and floors should precede any attempt to sanitize them. It is far easier to sanitize clean surfaces than surfaces that are soiled. Cleaning of surfaces in fruit and vegetable processing marketing areas should be carried out using mild USDA-approved alkali cleaning compounds such as sodium carbonate, trisodium phosphate (TSP), tetra sodium pyrophosphate (TSPP) and others. Use only cleaning agents that are acceptable and approved for use on food contact surfaces even when cleaning walls, ceilings and floors. The use of cleaning agents and scrubbing with brushes is helpful in removing microbial biofilms. Frequent cleaning is a good way to prevent the buildup of microbial biofilms. The following procedures should be followed to clean and sanitize equipment, utensils, room walls, ceilings and floors.

1. Rinse the area to be cleaned with low pressure lukewarm or cold water to remove gross soil.
2. Add a mild alkaline cleaning compound to hot water (130°F-160°F) or at a temperature recommended by the cleaning agent manufacturer.
3. Scrub away soil that the alkaline cleaning compound has loosened using a brush.
4. Rinse with cool or lukewarm water.
5. Apply the chlorine sanitizer solution at a temperature of 100°F and let stand for 20-30 minutes.
6. If the sanitizer concentration is greater than 200 ppm rinse it off with potable water.
7. If the sanitizer concentration is less than 200 ppm it is not required that it be rinsed off; rather allow the item to drain and then air dry. There is no regulatory requirement to rinse the sanitizer off, however concerns about corrosion may make it advisable to do so.

[1]A teaspoon contains 4.9 milliliters of fluid.

After walls, ceilings and floors have been cleaned, sanitized and allowed to drain and air dry an application of quaternary ammonium compounds (QUATS) will act to retard further microbial growth for 1 to 2 months. The QUATS can be applied at a concentration of up to 200 ppm in water by wiping, brushing or spraying. QUATS are effective sanitizers and are FDA-approved for use in sanitizing solutions for food processing equipment and utensils and other food-contact articles by 21 CRF 178.1010. The chemical category of QUATS is n-alkyl benzyl-dimethyl (or dimethyl ethyl) ammonium chloride. QUATS have attributes that chlorine-based sanitizing agents do not. They provide a relatively long lasting residue that inhibits the growth of molds and some other microbes and they are heat stable, effective over a wide pH range, are noncorrosive and are less affected by organic matter than chlorine. Like chlorine, the maximum level of QUATS permitted for use on food contact items without a preuse rinse is 200 ppm. Compared to chlorine, QUATS are slower acting germicides and are less effective against gram-negative bacteria.

The procedure used to clean and sanitize small equipment items is similar to the procedure used for large equipment and machinery. Because the hands of workers will contact the cleaning/sanitizing solutions for small equipment they must be less irritating. A mild alkaline cleaner with 0.03 percent (300 ppm) of active alkalinity is advised. The small equipment should be placed into a "bath" of the cleaning solution at a temperature of about 125°F for 15 to 30 minutes. This enables the loose soil and dirt to be brush scrubbed off. Rinse the equipment in hot water and then spray or dip treat it with a sanitizer solution (the 100 ppm chlorine sanitizer solution previously described or a 200 ppm QUAT solution). Finally, allow the equipment to drain dry.

The alkaline cleaning materials, QUATS and wetting agents can be obtained from cleaning compound supply firms such as:

Anderson Chemical Company

DuBois

Hydrite Chemical Company

Oakite Products, Inc.

Rochester Midland Corporation
Food Industry Division

The preceding does not constitute an endorsement of any company, manufacturer, or product.

References

Principles of Food Processing Sanitation, 2nd Edition, A.M. Katsuyama, ed. (The Food Processors Institute, Washington, D.C., 1993).