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Benefits of Using PAA-Based Products as Antimicrobial Intervention for Vegetable Wash

Fruit and vegetable processors use antimicrobial products to treat their fruits and vegetables in order to reduce their microbial load and extend their shelf-life. They also suppress the growth of pathogenic microorganisms, such as *Salmonella*, *E. coli* and *Listeria* and reduce their numbers on treated produce.

Antimicrobial products that are used to wash fruits and vegetables are regulated by two different regulatory agencies depending on their intended use. Unprocessed fruits and vegetables that are Raw Agricultural Commodities (RAC) are regulated by the EPA. However, processed fruits and vegetables, including cut fruits and vegetables, are regulated by the FDA. The FDA-approved antimicrobials are called Food Contact Substances (FCS). Upon approval, the FDA grants the supplier of the FCS with a Food Contact Notification (FCN), which is the primary method in which the FDA regulates the FCS and its intended uses and applications.

There are different types of antimicrobial products that are approved for use on fruits and vegetables, including bleach (sodium hypochlorite), chlorine dioxide (ClO_2), peracetic acid (PAA), organic acids, etc. One of the most widely used antimicrobials is a blend of peracetic acid/hydrogen peroxide (PAA/HP). Usually, this chemical combination is referred to as a PAA product. In addition to its use as an antimicrobial agent for treating fruits and vegetables, PAA has also been used for direct applications on other types of foods, including poultry, red meat, seafood, nuts, fruits and vegetables, etc.

In this article, we will focus on the benefits of using PAA as an antimicrobial for treating/washing fruits and vegetables. In some instances, I will compare PAA to sodium hypochlorite, because it's common for scientists, regulatory agencies and chemical suppliers to use bleach as a standard for comparing these types of chemicals and their applications.

Benefits of Using PAA for Fruits and Vegetables Wash:

1. Peracetic acid is one of the **strongest, most-effective oxidizing antimicrobial products in the market**. Its oxidation potential surpasses that of chlorine and chlorine dioxide. This oxidizing power is very effective against a wide variety of pathogenic microorganisms, such as *Listeria, Salmonella* and *E. coli,* etc. It also deactivates viruses and spores.

   When produce is washed with a PAA solution, PAA oxidizes the outer cell membrane of the microorganisms that are present on the produce and in the wash water. The oxidation mechanism is mainly electron transfer. When PAA is used, the electrons are transferred to the microorganism very quickly, causing the microorganism to be rapidly deactivated or killed. Another mechanism by which PAA deactivates microbial cells is by rupturing their cell walls upon contact. As a result, the microbial cell components will leak out of the cells and the microbial cells die. Additionally, PAA can inactivate important functional enzymes in the microbial cells.

2. Also, many PAA antimicrobial products, including AFCO's AF4325, AF4360, and AF4367, **are certified for use in ORGANIC production facilities** as surface sanitizers and for direct application on food. The active ingredients in these types of products break down completely to non-harmful components. When dissolved in water, peracetic acid disintegrates into hydrogen peroxide and acetic acid, which will break down into **water, oxygen and carbon dioxide**. PAA degradation products are non-toxic and can easily dissolve in water. This means that PAA products leave no chemical residues on treated foods nor on treated surfaces. After killing the microorganisms, PAA and HP degrade and disappear. (It is reported that the half-life of PAA is 8-30 hours).

3. Bleach, although it can be used in organic production facilities, including vegetable wash, will leave chemical residues on foods. Also, it can react with food tissues (organic matter) and form carcinogenic substances. This is the reason some countries in the world banned bleach for use on food, including Russia. This could also be the reason our EPA asks that if bleach is used to wash fruits and vegetables, treated fruits and vegetables should be rinsed with fresh water before packaging.

   On the other hand, when PAA is used, treated fruits and vegetables DO NOT need to be rinsed again with fresh water after treatment and before packaging. This brings us to another benefit of using PAA vs. bleach, which is "savings". Because PAA-washed produce does not require a subsequent water rinse, produce processors can save a lot of water and time. Also, they do not need to spend extra money on installing equipment for the potable water rinsing step.

4. Another benefit of using PAA over bleach is that PAA has a much higher tolerance to organic load (produce in the wash water) than bleach. PAA activity is hardly influenced by organic compounds in the water. So, you do not need to inject PAA into the produce wash water as frequently as if you would with bleach. Bleach degrades quickly in the presence of high organic load. To keep an effective concentration of bleach in the wash water, you need to continuously inject bleach into the wash water. Therefore, even though bleach is less expensive than PAA, you will need large amounts to do the job. This can result in almost the same bottom-line cost as if you use PAA.

5. Additionally, if bleach is used as an antimicrobial in the produce wash water, you need to also inject an acid to maintain the pH of the bleach solution at 6.5 for maximum microbial inactivation. With PAA, you do not need to worry about adding another chemical. Only dilute the PAA product with water and you are good to go.

6. As mentioned above, unlike bleach, PAA is environmentally friendly, because it does not interact with organic matter to form carcinogenic material. Bleach, on the other hand, interacts with organic matter (e.g. produce tissues in the wash water) and forms carcinogenic substances that are dangerous to humans. Also, when bleach solutions are dumped into the drains, bleach will interact with the organic matter in the drain and form carcinogenic substances, such as chloroform, which can emit from the drains as gas and can be hazardous to plant workers.

7. Additionally, when chlorine is used throughout the day to wash fresh produce, the wash water continuously emits chlorine gas into the plant environment. This chlorine gas can oxidize and

damage the processing equipment. The first sign of that is the appearance of flash rust on the metal surfaces in the processing areas, including processing equipment (even on stainless steel) and overhead structures surfaces. Remember, rust is a chemical reaction called “oxidation”. The oxidation reaction of the metals is like a chain reaction - once it starts, it will never stop. Therefore, in the long run, all your processing equipment will be covered with rust. This oxidizing/rust effect also applies to ozone when used as an antimicrobial product to wash produce. Ozone is a very reactive oxidant. Therefore, it can oxidize and ruin your processing equipment and other oxidative surfaces in your processing plant.

For recommendations and help with your antimicrobial produce wash systems, please contact your AFCO/ZEP representative. AFCO carries PAA-based antimicrobial products and their dispensing and dilution systems.

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