# Cost and Labor Effective Produce Sanitation Methods for Small Farms

## North Central Region SARE FNC14-967

*"The goal of the project was to develop a small farm produce washer/sanitizer for the more delicate crops like ripe tomatoes and English cucumbers. The washer had to minimize handling, maximize sanitation, and be affordable.*

**A washing, sanitizing set up for less than $500**

We began with a concept of some sort of surface over which we could spray wash and sanitize the produce in significant quantities. We located a used 150 gallon (3' X 5') stainless steel meat cart and sheets of plastic extruded flooring. Laying the flooring on the cart provided an ideal surface for washing, sanitizing and drying the produce.

The greenhouse facility we purchased had a cooler room they had used for storing flowering plants. We skinned the room with painted metal roofing and installed lighting and brought in both hot and cold water lines.

We included a thermometer to ensure the temperature of the water stayed consistent.

In a few minutes one person can quickly wash more than 90 English Cucumbers averaging 14-16" long. This process takes a fraction of the time compared to the previous method we used, which was hand washing and wiping each individual cucumber. The English cucumbers, like tomatoes, have a delicate skin and can be damaged easily.

It was important that we used a sprayer head and sufficient water pressure that the produce was washed but not bruised. Since they are greenhouse grown, we didn't soil on them as may be present on field grown, but we tested the system on some field grown produce and it successfully washed off

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For tomatoes, we found that washing in the same crate that we picked into to wash was the most efficient. We purchased a variety of different picking crates, with the additional requirement that the crates would work in our second generation produce washer. They also needed to stack, be tall enough for the largest tomatoes and fit on some kind of wagon or rolling wheels to move around the greenhouse. The best option turned out to be commercial open dishwasher racks, however we would like to find one that had rounded plastic edges on the bottom rather than angular.

Our second effort involved modifying a used commercial dishwasher to automate the process.

Originally we had planned to build a power conveyor with nozzles above and below. But we found a used commercial dishwasher, readily available on on-line auction sites, fully enclosed with power mover and washing units. The problem is that it was 3 phase and used 225 gpm of water in a recirculating system.

We replaced the phase 3 motor with a single phase, locked the drains open and replumbed the systems nozzles.

We used temperature controlled potable water for washing and a dosatron to control the concentration of the sanitizer.

Commercial dishwashing unit as received. It was 3 phase and pumped 225 gpm. Just a little excessive for washing tomatoes.

The cleaned and renovated unit, empty and view of tomatoes and cucumbers entering the system.

Tomatoes exiting system onto stainless counter included with washer.
<—

View into washer with water guard removed.

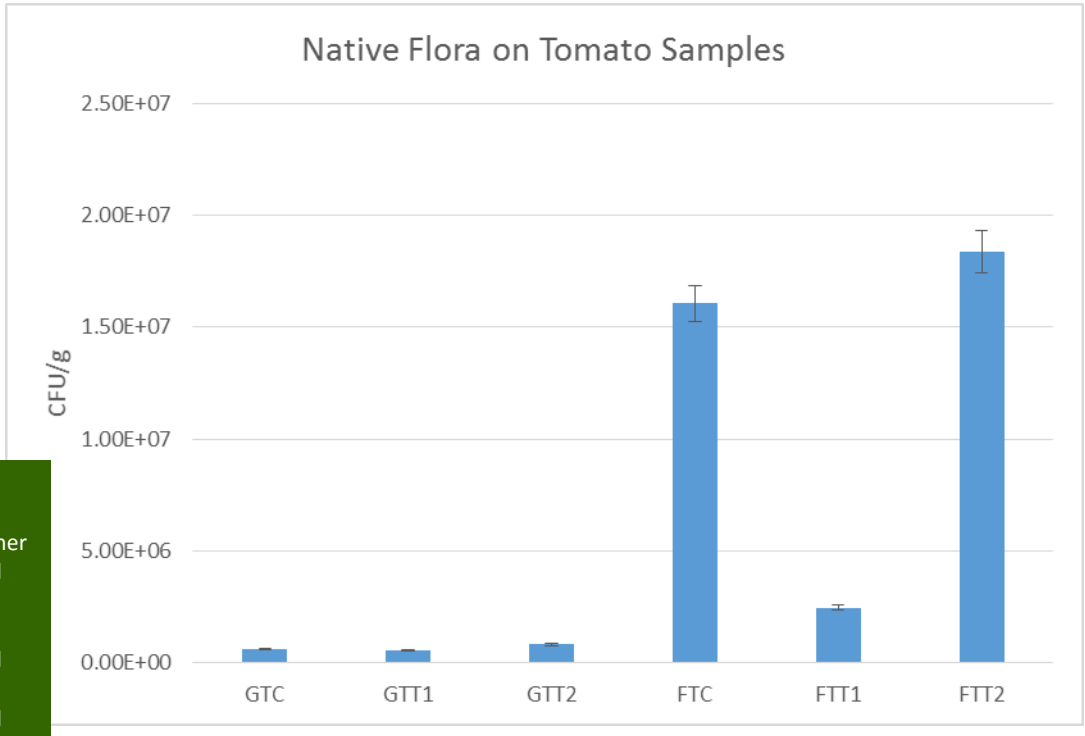
Loading washing lugs with cukes.

Sanitizer concentration should be confirmed with testing strips.

Temperature control of wash water is important

The effectiveness of the two systems was evaluated by looking at the microbial populations on unwashed produce as compared to the two washing methods. Total Plate Counts and Coliform counts were analyzed by Dr. Amanda Deering and her graduate assistant YooJung Heo from the Food Science Department at Purdue University. Each washing procedure was conducted on greenhouse grown tomatoes, greenhouse grown cucumbers and field raised tomatoes. When comparing the Total plate count for bacteria in the un-treated product, the field tomatoes had a much higher total bacterial load then the greenhouse produced product. Greenhouse grown tomatoes had an average total plate count of 6.12 x105 while field grown toma-toes averaged 1.61 x 107 CFU/gram of product. Coliform bacteria, those most likely to cause a food borne illness, were present in both samples. For greenhouse grown, 3/10 tomatoes contained coliform and 9/10

It is important that we understand that produce often contains bacteria that can cause food-borne illness, regardless of the production method. As produce suppliers we need to recognize and look for ways to address it.




GTC= Greenhouse Tomato Control
GTT1= Greenhouse Tomato washed in modified dishwasher
GTT2= Greenhouse Tomato washed on flat system
FTC= Field Grown Tomato Control
FTT1= Field Grown Tomato washed in modified dishwasher
FTT2= Field Grown Tomato washed on flat system

# Impact of Postharvest Treatment Methods for Fresh Produce

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## INTRODUCTION

Postharvest practices and handling of fresh fruits and vegetables is important to prevent foodborne illness. Various sanitizers, such as chlorine, chlorine dioxide, and peroxyacetic acid (PAA), are added to postharvest water and are routinely used by growers. These sanitizers not only kill microorganisms in the water to reduce the likelihood of cross contamination, but also help to reduce the microorganisms present on the surface of the product to potentially increase the safety and shelf-life of the product (Francis et al,1999). However, It is critical that the postharvest treatment is done correctly. It has been reported that 92% of growers wash their produce on farm, but only 16% of them use proper sanitizers or use them correctly (Rangarajan, A., & Pritts, M., 2002). Implementing an effective postharvest sanitization program can be challenging for small growers, from both a cost and implementation standpoint, so it is essential to investigate the effectiveness of sanitizers and methods to sanitize the products to give small growers insight into the effectiveness of a particular method and treatment.

## MATERIALS & METHODS

**Harvest :** Greenhouse cucumbers and tomatoes were harvested and field tomatoes were obtained from a local produce auction. The samples were then treated as described in the Treatment Methods.

**Plating and Incubation**: A total of 10 replicate samples of greenhouse tomato, field tomato and greenhouse cucumber with control, Treatment 1 and Treatment 2 were collected. For each sample, 25 g was measured and blended with 22 5ml of 0.1 M phosphate buffer (pH 7.0) for 1 minute. Then, 100µl of the blended sample was plated on total plate count agar in order to identify the total background bacteria on the product and incubated at 36°C for 2 days. In addition, 1 ml of sample was also plated on 3M Coliform Petrifilm™. To enumerate the yeasts and molds present on the greenhouse grown cucumbers, 1ml of the sample was plated on the 3M Yeast/Mold Petrifilm™ and incubated at 25°C for 3-5 days.

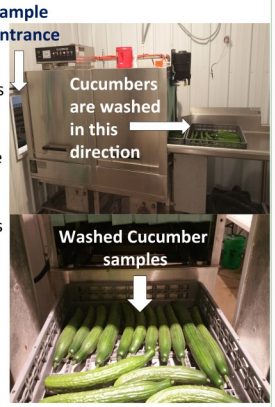
## OBJECTIVES

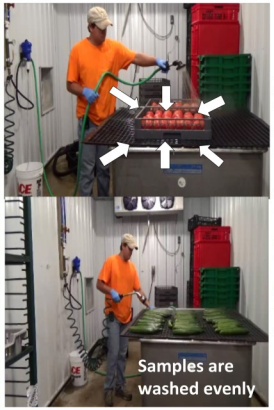
- To identify the impact of different methods of postharvest treatment with PAA on greenhouse grown tomatoes and cucumbers.
- To investigate if sanitization with PAA could prolong the quality and shelf-life of the fresh produce.

## TREATMENT METHODS

Different application methods of PAA were tested.

**Treatment 1**: Samples were sent through the machine on a conveyor belt and the PAA solution was applied from the top and bottom. With this method, the initial start up cost may be higher, but labor costs can be saved.




**Treatment 2:** The PAA solution was manually applied from various direction with a spray nozzle by a person. In this method, the implementation costs are low, but requires increased labor costs. Arrows indicate that the samples were washed on both sides.

## RESULTS

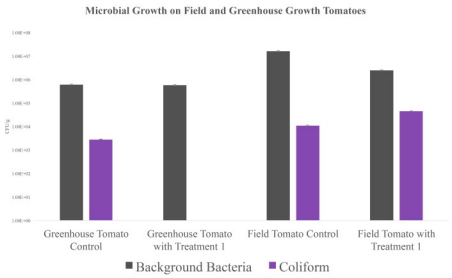



**Figure 1.** Microbial quality of field and greenhouse grown tomatoes following Treatment Method 1 with 40 ppm PAA.

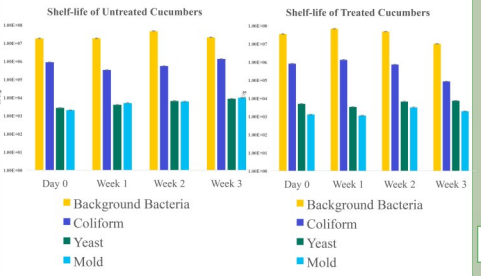



**Figure 2.** Microbial quality of cucumbers following Treatment Method 1 with 80 ppm PAA and storage at 4°C for 3 weeks.

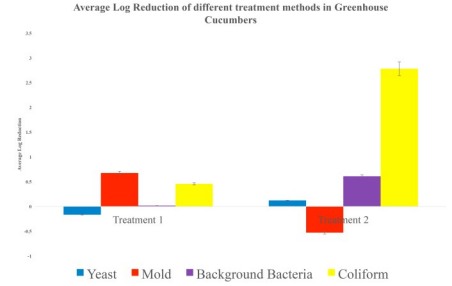



**Figure 3.** Average log reduction of yeast, mold, background bacteria and coliforms following Treatment Method 1 and Treatment Method 2 with 40 ppm PAA.

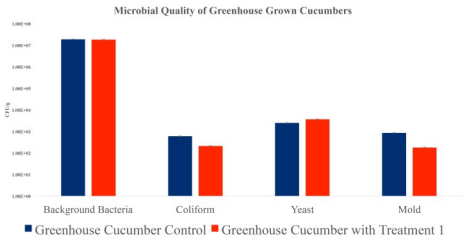



**Figure 4**. Microbial quality of greenhouse grown cucumbers following Treatment Method 1 with 40 ppm PAA.

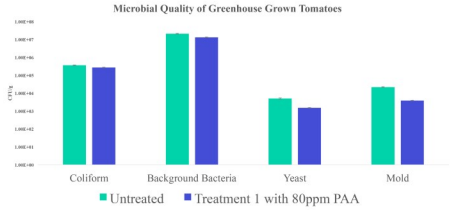



**Figure 5.** Microbial quality of greenhouse grown tomatoes following Treatment Method 1 with 80 ppm PAA.

## CONCLUSIONS & FUTURE DIRECTION

- PAA was effective at reducing the microbial growth and prolonging the shelf-life of tomatoes and cucumbers.
- Other sanitizers, such as chlorine and chlorine dioxide, may be used in addition to PAA for an increased reduction.
- Further education and assessment of postharvest treatments for small growers are important to reduce food safety risks.

## ACKNOWLEDGEMENTS

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