Washing Produce

Michael Donaldson, PhD
Hallelujah Acres Foundation
Spring, 2005

Background

Fresh fruits and vegetables may have potentially pathogenic bacteria on them that need to be removed in order to be eaten safely. Also, some produce may have fungicides and possibly pesticide residue on them. Much of the pesticide is gone before harvest, but fungicide is often applied post harvest to prevent spoilage during transport, storage.

There are several possible solutions. Even organic produce may have potentially pathogenic bacteria on them. Vegetable washes can be used. Hallelujah Acres Vegetable wash is representative of this category. Vinegar and hydrogen peroxide spritzing has also been reported to remove bacteria from surfaces (http://www.mercola.com/fcgi/pf/2001/jul/21/vinegar.htm). This method may also degrade fungicides and pesticides via free radical damage, as peroxide can effectively generate free radicals in an acidic environment. Peroxide's action in an acidic solution is the basis of the sanitizer peroxyacetic acid used commercially. A third alternative is the Sampson Multi-Washer, which cleans and sanitizes with ozone, ultrasound, and positive silver ions.

These three methods of sanitization were tested side by side to determine the efficacy of each approach.

Methods

Fresh produce was chosen from a local grocery store. In the trials here spinach was used, though other vegetables were proposed to be tested after initial results with spinach, depending on outcome.

For each sample, 25 g of spinach were weighed on a lab balance. This was then blended in a sanitized Champ HP3 blender on cycle 2 (about 30 second blending) with 225 ml of sterile 0.1% peptone (10-fold dilution). After blending the pH was adjusted, if necessary, to between 6.8 and 7.2. For spinach only the vinegar / peroxide treatment required adjustment. A sample of this was saved in a sterile test tube for plating total aerobic bacteria and yeast and mold cultures.

The vegetable wash concentrate was sprayed at the recommended dilution directly onto the spinach and the leaves rubbed to ensure good contact and left for approximately 2-3 minutes before rinsing. The vinegar (full strength white vinegar) and hydrogen peroxide (3 %, kept in dark bottle) were sprayed onto the spinach leaves and rubbed as with the vegetable wash. The Samson washer was put on a 10 minute cycle with all of the spinach leaves submerged.

The saved blended samples were put into sterile microfuge tubes and centrifuged for 1

minute at 16,000 X g to pellet food particles that might interfere with reading the plates. This treatment does not centrifuge down any suspended bacteria. Twenty-fold dilutions (200, 4,000, 80,000 and 1,600,000) were made of each sample, as necessary to bracket the concentration of bacteria for accurate counting. One ml of the appropriate dilution of sample was pipetted onto the PetriFilm®. After at least one minute for allowing the gel to form and stabilize, the PetriFilms® were incubated at 35˚F for two days for aerobic plate counts and at room temperature for 5 days for yeast and mold counts. Colonies were then enumerated from the plates that had between 20 and 300 counts. All dilutions were done in triplicate.

Results & Discussion

Table 1 shows the results from two separate experiments. The vinegar / peroxide treatment had a 1.5 log reduction in run 1 and a 1.9 log reduction in experiment 2. The vegetable wash and Samson washer both performed about the same, giving a slight reduction in the first run and no reduction in the second experiment.

Reduction of yeast and mold was difficult to determine on spinach since the overall counts were so low.

As a result of the poor performance of the Samson washer it was decided no to do further experiments with the machine.

Table 1. Aerobic Plate Counts from Treatments.

Run 1: Spinach			
	cfu / g spinach	log	log reduction
Control	1.40E+05	5.15	
Vinegar / Peroxide	4.40E+03	3.64	1.50
Vegetable Wash	2.90E+04	4.46	0.68
Samson washer	3.00E+04	4.48	0.67

Run 2: Spinach			
	cfu / g spinach	log	log reduction
Control	2.00E+04	4.30	
Vinegar / Peroxide	1.70E+03	3.23	1.07
Vegetable Wash	1.05E+05	5.02	-0.72
Samson washer	2.10E+04	4.32	-0.02

Literature from Green Bison indicates that the Samson multi-washer effectively kills pathogenic bacteria in an unspecified test. It is possible that it is much more difficult to kill naturally occurring, non-pathogenic aerobic bacteria on the surface of spinach and other fruits and vegetables than it is to kill added pathogenic bacteria. Note that none of the treatments yielded a complete destruction of bacteria on the surface. Naturally occurring aerobic bacteria are notoriously difficult to kill on the surfaces of leafy greens and grasses. It is likely that these bacteria are almost integrated into the surface so that they are somewhat protected from environmental assaults. These bacteria are generally non-pathogenic and do not cause harm.

Conclusion

The vinegar / hydrogen peroxide spray treatment is the best treatment for reduction of aerobic bacteria on the surface of spinach. Vegetable wash and the Samson washer are not preferred methods for anti-bacterial treatment of produce.

Removal of fungicide and pesticides weren't tested. Limited public knowledge is available on exactly what is sprayed on which crops. Suppliers don't know what is on the crops, grocery stores don't know either. Anyways, since performance for bacteria was so ineffective, the testing of fungicide removal was not pursued further.

Note that 25 grams of spinach is a very small load for the Samson washer. If performance is like this with a small load, how will it do better when the basket is full?

This testing does not determine whether the vegetable wash is successfully able to remove waxes from produce. Even the vegetable wash has questionable value for treating produce. It appears that truly the best treatment for bacteria (and probably for chemicals as well) is vinegar and peroxide.