Western Vegetable Newsletter

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1. Largest Vegetable-borne Outbreak in US History: Source Uncertain but Much to Learn

During late November it was very hard to find fresh green onions in food served at restaurants. That was the situation after more than 600 hepatitis cases in Pennsylvania were linked with green onions from Mexico, including three deaths. The source of the virus is still unknown, and may not be possible to discern, but based on what we know about this virus we may draw some speculations on how it became such a problem and how to minimize these types of situations.

Hepatitis A virus (HAV) is a liver disease that develops within 2-6 weeks after exposure. Hepatitis A is usually mild and characterized by jaundice, fatigue, abdominal pain, loss of appetite, nausea, diarrhea and fever. HAV is spread by human feces through the fecal-oral route.

Mexican health and agricultural authorities are fully cooperating in this case while questioning why the FDA is focusing at the production area as the most likely suspect. One of the first important clues were that the strains of HAV found in Penn. (and Georgia and Tennessee) are strains commonly seen either in US residents who have traveled to Mexico and contracted HAV or in residents living along the US-Mexican border. Despite this, it is interesting that there have been relatively few reported cases of hepatitis A in the area where the green onions are grown (northern Sonora and Baja California). However, FDA response was that some individuals infected with Hepatitis A virus, children in particular, may have no symptoms or very mild symptoms. Adults who contract the disease in childhood are immune for life, providing protection in countries where hepatitis is widespread. In the United States, where it is not as common, the disease can cause devastation because adults here are not usually immune and an outbreak can begin with a single infected person.

Health officials initially expressed that the contamination may have been caused by tainted water, children in diapers roaming the fields, or poor hygiene among farmworkers. During early December representatives of the FDA inspected the areas and facilities in areas where it is thought that the green onions came from. Among the four main suspect companies only one appeared not to be complying with good agricultural practices (GAP), in particular, this packaging facility was rinsing vegetables with untreated water. Clearly this doesn't confirm that the HAV originated at this location.

Moving up another step in the food preparation chain we need to remember that those green onions consumed in Beaver County, Penn. were re-iced because buyers like to receive green onion shipments with fresh ice. However, federal authorities eliminated the re-ice as the contamination point because they reasoned that a lot more people would have gotten sick, not only from eating green onions, but with other products that are re-iced.

Thirteen of the restaurant workers were also positive for hepatitis A, all becoming ill after the outbreak. The average incubation period for hepatitis A is 28 days, which suggests that the workers contracted the virus in early October, precisely during the same days restaurant customers consumed the green onions. This is why the FDA dismissed the food workers as the source of the outbreak. It is clear however, that inappropriate handling practices contributed to the virus being spread to so many people. This has been the largest food borne outbreak ever reported due to a single food source. The virus is killed by heating to 185 F (85C) for 1 minute. Rinsing with chlorinated water (for example 10 ppm for 5 min) also destroys HAV. Evidently neither one of these practices was followed in the restaurant.

Although the exact source of contamination will be hard to establish, this case has taught us that poor practices at one point in the food production chain cause many problems, but lack of good practices at several points can have catastrophic results.

2. **Applying Methyl Jasmonate to Enhance Quality of Fresh-Cut Vegetables.**

There are very few approved biological or chemical agents available to the vegetable fresh-cut industry to enhance the shelf life of products. During the last five years however, several studies have shown evidence pointing to methyl jasmonate (MJ) as a good addition to the processing of fresh-cut vegetables.

The most dramatic results with MJ on fresh cuts have probably been those reported by researchers Buta and Moline from ARS-USDA, Beltsville, MD. Their study showed that the application of MJ vapor retarded deterioration of celery sticks for 2 weeks and bacterial colonies were reduced to 1/1000 of the control after 1 week of storage. MJ emulsion (with Tween), applied as a dip, retarded deterioration of green pepper strips for 2 weeks and the number of bacterial colonies was reduced to 1/1000 of the control. Reduced browning of fresh-cut celery and control of soft rot on peppers were highlighted as benefits of this treatment.

Other studies from Beltsville and other sites have shown that MJ may inhibit postharvest sprouting of radishes, reduce mold incidence in grapes, enhance alkaloids content of medicinal importance in purple coneflower and reduce chilling injury in mangoes.

Jasmonic acid, and derivatives such as MJ, have been described as signaling compounds that stimulate the expression of wound-inducible and defense-related genes, as well as being involved in many developmental processes in plants. Their hormonal effect has been studied for a relatively few years. We are not aware of any fresh-cut company that is currently using this technology, however, the above information suggests that jasmonate deserves attention as an alternative to extend the shelf life of fresh cut vegetables. We will be reporting on local experimentation within the next months, including evaluation of the effect of this growth regulator on transplanting stress.

3. More Studies indicate *E. coli O157: H7* Can Contaminate Lettuce in the Field

Different studies continue to examine the possibility that *E. coli* could contaminate lettuce tissue during the crop growth and eventually be present in high levels at the consumption point. Studies conducted by USDA-Beltsville researches and by a group of food scientists at Rutgers University showed results suggesting that pre-harvest crop contamination from irrigation water can occur through lettuce roots or by contamination of leaves.

In the first study *E. coli* in young plants multiplied few days after inoculations of the soil. This study was conducted in greenhouse conditions and may not be indicative of what is really occurring in the lettuce fields. Research from British scientists showed previously that 50% of all E. coli declines in less than four days in soil at temperatures between 50 and 77 F. This suggests that under normal conditions most E. coli in soil declines rapidly. However, if irrigation is not furrow or underground, or if E. coli is present in the field right before the harvest day, the possibility of high pathogen numbers at the retail site increases. The study conducted in growth chambers by Rutgers scientists demonstrated that repeated spray irrigation containing *E.coli O157:H7* results in contaminated lettuce at harvest.
Other results have suggested that lettuce tissue damage incurred in the field increases the potential risk for *E.coli* contamination. In injured tissue, even chlorine treatments (100 ppm) may fail to reduce *E. coli*. Removal of *E. coli* and other pathogens from lettuce is better achieved with chlorine solution at warm temperatures (50 C). The warm water also extends the shelf life and visual quality of fresh-cut lettuce by keeping the enzyme that leads to tissue darkening along the cut edges from activating.

Although research suggests that there is a potential risk of *E.coli*-contaminated lettuce, the reality is that *E.coli* brought from crop fields has not been a real problem. The Centers for Disease Control and Prevention estimates that 73,000 *E coli O157:H7* infections occur each year, with 61 deaths, but very few cases has been linked with lettuce contaminated in the field. Water quality, irrigation prior to harvest and postharvest disinfecting treatments, appear to be of paramount importance in reducing the risk of E. coli in lettuce at consumption point.

4. The Journal Magnifier:

Titanium Applications Increased Calcium Uptake, Yield and Quality

The use of titanium to enhance nutritional absorption in plants has recently been studied by several research groups in Europe. In the last issue of the Journal of Plant Physiology an article entitled “Effects of foliar sprays containing calcium, magnesium and titanium on plum fruit quality” by Alcaraz-Lopez and others, highlights the benefits of titanium applications.

In this study all the plants treated with titanium showed significant increases in their fruit diameter and weight. Also the peel and flesh of the fruits from titanium-sprayed trees were significantly more resistant to several postharvest handling injuries than the control.

The physical quality improvement induced by titanium was attributed to the differences in the calcium concentration of fruits. The titanium-treated trees had fruits with approximately 20% higher calcium concentration in the peel, and nearly 40% higher in the flesh.

The authors also suggested that the beneficial effect of titanium was due to the activation of Fe (Iron) in leaf chloroplasts and fruit chromoplasts. Increased activity of Fe in chloroplasts and chromoplasts results in increased metabolic activity and nutrient absorption.

A group of researchers from the Czech Republic previously suggested that the biological effects of Ti, including the increase of Fe and Mg in plant tissues, the increased enzymatic activity and increased in chlorophyll biosynthesis are the defense mechanism of the plant to Ti replacing some essential elements at their binding sites. In other words, these defense mechanisms are stronger in Ti-fertilized plants as the plants try to eliminate Ti toxic effects. A similar process, called hormesis, has been described for lead (Pb) and its effect on hemoglobin in blood.

Titanium fertilization could have some applicability in western industry but this has to be evaluated. Plans have been made to study this factor in the near future at the Yuma Agricultural Center, as part of a program that evaluates microelements on the quality of vegetables. Your input on this issue would be highly valued.

5. Ask the specialist:

- Is there any regulation that establishes how often water in potato processing and packaging facilities needs to be changed?

Precautions in the use of water for processing potatoes should be just like those with any other produce. Perhaps with the only difference that a product like potatoes, as with other roots and tubers, tend to fill the tanks with organic matter more quickly.

It is the law to follow good agricultural practices (GAP) and good manufacturing practices (GMP) as recommended by USDA guidelines. However, you will not find in those guidelines anything specifically related to the maximum period of time a rinsing tank can hold water. This is clearly because not all food processes are the same. The load of produce, the natural quality of the water, the organic matter in the product and the concentration of the disinfecting agent, all will make a difference.

To help in monitoring the effectiveness of the water to disinfect produce many packers and fresh-cut processors have decided to use Oxidation-Reduction Potential (ORP), measured in milivolts (mV). Several studies have shown that at an ORP value of 650 to 700 mV kill bacteria such as *E. coli*, *Salmonella* and *L. monocytogenes* within 30 seconds. According to studies of Univ. of California-Davis, for clean water, 5 ppm of free chlorine will yield near 650 mV ORP, which provides sufficient microbial control for free floating bacteria. For most post-production systems, a maximum level of 800 mV ORP is recommended.

In conclusion it is wise to check the USDA guidelines for fresh-cut processing, which can be found at: http://www.cfsan.fda.gov/%7Edms/prodglan.html
Other food safety information may be seen at:
http://cals.arizona.edu/crops/vegetables/quality/veg_safety.html

Water in processing facilities should be changed as soon as turbidity in the water becomes a concern, especially on those tanks where the final rinsing occurs. If the disinfecting agent used is chlorine, ORP values must always be above 650. Preferably use inorganic food grade acids such as muriatic or phosphoric acid to lower pH. Citric acid interferes with the lethal action of hypochlorous acid according to recent studies of ARS-USDA. Other units may be more convenient when the disinfecting system is based on ozone or peracetic acid, consult the product provider.

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Arizona Crop Information Site
www.cals.arizona.edu/crops/

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