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In This Issue

SPECIAL EDITION of the VegNet Newsletter

[Editors Note: This special edition presents a summary of some of the latest information on the E. coli outbreak in spinach. The article begins with excerpts from a review paper soon to be published in the Journal of Food Science written by scientists from OSU. The paper was submitted in April 2006 and details vegetable food safety concerns that are so much in the news today and affect our industry. Thanks to Dr. K. Lee (OSU Food Sci. Dept.) for giving me an advanced copy as well as permission to use some of this information in our newsletter. The end of the newsletter contains the latest news release from the FDA as well as some information on the Lettuce Safety Initiative and the 2004 Action Plan to Minimize Foodborne Illness Associated with Fresh Produce Consumption. More complete and detailed information can be found by following the web links to the FDA]

Fruit and Vegetable Microbiological Safety Concerns

From the paper: Interactions Affecting the Proliferation and Control of Human Pathogens on Edible Plants by D. ARUSCAVAGE, K. LEE, S. MILLER, AND J.T. LEJEUNE to be published in the Journal of Food Science *MS20060206 Submitted 4/12/2006, Accepted 8/15/2006. Authors Aruscavage and Lee are*

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ABSTRACT: Pathogens on edible plants present a significant potential source of human illness. From 1991 to 2002, 21% ofEscherichia coli O157: H7 outbreaks were from produce-related sources. E. coli O157and other enteric bacteria can contaminate the surface of edible plants both pre- and postharvest. Some pathogens do not survive on the leaf surface or are removed by washing, but a significant portion of these enteric pathogens can persist on the surface and proliferate. Proliferation of these dangerous pathogens can increase the likelihood of foodborne disease associated with fresh or minimally processed produce.

Increased consumption of minimally processed fruit and vegetables has focused attention on how the microenvironment of these plants affects produce safety. This microenvironment can help or hinder food safety, affecting proliferation and persistence of enteric pathogens on plants.

Unreported before the 1990s, it is no longer surprising that a significant number of outbreaks of foodborne disease can be linked to fresh produce. By the mid 1990s, illnesses associated with cantaloupe, tomatoes, alfalfa, lettuce, and several other fruits and vegetables were documented (Tauxe 1997). The United States Department of Agriculture (USDA) recommends adults consume five cups of fruit and vegetable products daily to maintain good health (mypyramid.gov). The United States has become a major net importer of fruits and vegetables, with imports more than doubling during the decade 1994 to 2004 to reach a record $12.7 billion (http://tse.export.gov). This huge array of global produce has questionable safety and represents a large potential source of foodborne illness. With increased consumption and importation, the risk of foodborne illness associated with produce has increased (Beuchat 2002). Increased reporting by clinicians also provides a better surveillance system of produce-associated foodborne disease outbreaks (Suslow 2002).

The most common bacterial enteropathogens associated with fruits and vegetables are Salmonella spp. (Thunberg and others 2002). In 1990, a multistate outbreak of salmonellosis in the Midwestern United States was caused by consumption of raw tomatoes (Hedberg and others 1999). Cantaloupe and strawberries were also identified as sources of Salmonella outbreaks in the 1990s (Hedberg and others 1999). Rangel and others (2005) showed produce was the transmission vehicle for E. coli O157:H7 in 21% of the food borne outbreaks from 1982 to 2002 with the first recorded incident occurring on 1991. From 2000 to 2004, produce related outbreaks were usually the second most common identified outbreaks of E. coli O157 (Figure 1). E. coli O157 outbreaks were associated with apple cider, lettuce, radish, alfalfa sprouts, and other mixed salads since 1991 (Beuchat 2002).

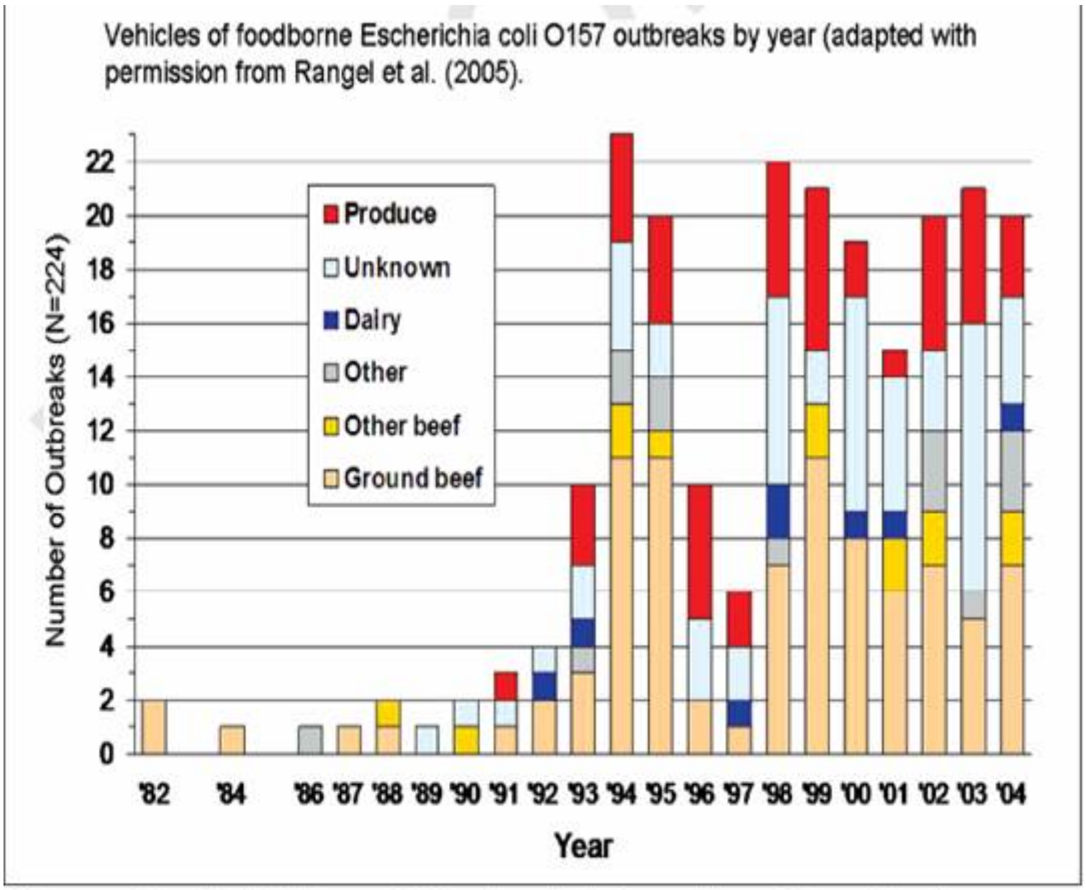

Figure 1 – Vehicles of *Escherichia coli* outbreaks by year, adapted with permission from Rangel and others (2005)

Figure 1

Washing of Edible Plants

Processing of fruits and vegetables results in cut surfaces and a prepackaged nonsterile food (Nguyen-the and Carlin 1994). Packaging implies a level of safety to some consumers that may or may not be achieved. Processing includes washing, trimming, possibly peeling or slicing, and a sanitation step (Carmichael and others 1999).Washing and sanitation steps are critical with produce because this type of food is often eaten raw.

Johnston and others (2005) observed an increase in microbial proliferation from harvest to processing. They found a 10-fold increase in microbial counts for cilantro from harvest samples to boxed and processed samples.

A produce sanitation step typically involves a solution of 50 ppm to 200 ppm chlorine that may or may not be necessary. Chlorine is as successful at removing bacteria as non chlorinated water, but it is necessary to keep the wash water free of contaminants (Zagory 1999). Chlorinated water does not sterilize produce, but Zhuang and others (1995) suggested using 200 ppm free chlorine in wash water to ensure some reduction of Salmonella Montevideo from tomatoes. Some producers feel that high concentrations of chlorine in the wash water cause esthetic problems with the product (Hurst and Schuler 1992). Beuchat (1999) found deionized water compared with a 200 ppm chlorine solution was equally successful at removing pathogens from the surface of lettuce. Solomon and others (2002a) used a 200 ppm chlorine solution to clean lettuce and found that it did not remove E. coli O157. Among potential reasons for the failure of chlorine washes are protected sites on the plant where these bacteria hide, avoiding contact with the wash (Leben 1988). Raiden and others (2003) determined detergents were as successful as water at removing Salmonella from strawberries and tomatoes. Most research indicates that enteric pathogens are removed from produce surfaces effectively with water, with chlorine, and with common detergents, yet chlorine is often considered mandatory for produce sanitation. Chlorine may help keep the rinse water clean but keep in mind there are other ways to do this.

Chlorinated water may only be as effective as water at disinfecting produce, but Han and others (2000) found chlorine dioxide (ClO_2) was much more effective than water. The authors found a 3.0 $\log_{10}$ reduction of E. coli O157:H7 when disinfected with 0.62 g/L ClO_2 and a 6.5 $\log_{10}$ reduction of E. coli O157:H7 when 1.24 g/L ClO_2.New technologies show promise for produce sanitation to ensure product safety. Harris and others (1999) tested an alkaline produce wash with Q15 generally regarded as safe (GRAS) components. The produce wash reduced Salmonella 2 to 4 logs more than the sterile water on the surface of tomatoes.

With current technology and packaging of fresh produce, microorganisms are present at the time of purchase in grocery stores. Farmers and processors must be vigilant in food safety, but so must consumers. Proper storage and cleaning before eating will help prevent foodborne disease associated with fresh produce. The U.S.FDA recommends buying produce that is not bruised or damaged and buying cut produce that is refrigerated or packed in ice. It is also recommended that all produce be washed with water before consumption, even if it is prepackaged. The U.S. FDA suggests scrubbing produce capable of handling it, but does not recommend use of detergents. It is important to realize that produce safety is now a partnership that requires attention from farmers, processors, retailers, and consumers.

Conclusion

In 2004, the FDA instituted an action plan to reduce food borne disease (see below) associated with fresh produce. The action plan calls for improvement in every step of produce production from the farm to the retail store (cfsan.fda.gov/~dms/prodpla2.html). To help in the improvement in these areas, we must fully understand conditions that affect the proliferation of enteric pathogens(Table 1). Microenvironmental changes can enhance or adversely affect survival and proliferation of these transient organisms. Surface characteristics can determine if enteric pathogens adhere to food, for example, protected sites on a leaf surface are important for survival of an organism. Such natural sites and created sites such as wounds may enhance survival and proliferation because additional nutrients and protection from drastic environmental shifts will help any microorganism not normally present in the phyllosphere.

Table 1 – Persistence of *E. coli* O157 and *Salmonella* in farm environments and produce

Persistence	Medium	Pathogen	Reference
1 yr	Nonaerated Sheep Manure	*E. coli* O157	Kudva and others (1998)
49 d	Dairy cattle manure	*E. coli* O157	Wang and others (1996)
63 d	Lettuce	*Salmonella Typhimurium*	Islam and others (2004)
161 d	Parsley	*Salmonella Typhimurium*	Islam and others (2004)
2 d	Fungicides	*E. coli* O157:H7	Guan and others (2005)
15 d	Fungicides	*Salmonella*	Guan and others (2005)
20 d	Lettuce	*E. coli* O157	Solomon and others (2002)
21 d to 45 d	Fallow soil	*E. coli* O157	Gagliardi, Karns (2002)
47 d to 96 d	Alfalfa	*E. coli* O157	Gagliardi, Karns (2002)
100 d	Grassland	*E. coli* O157	Bolton and others (1999)
49 d	Tomato	*Salmonella* Montevideo	Guo and others (2001)
27 d	Tomato	*Salmonella* Poona	Guo and others (2001)

Table 2 – Effectiveness of sanitation methods used on fruits and vegetables infected with enteric pathogens

Method	Dose	Effect	Reference
Water	Spray for 1 or 5 min	Approx. 2.5 $\log_{10}$ reduction of *E. coli* O157:H7	Beuchat (1999)
Chlorinated water	200 ppm spray for 1 or 5 min	Approx. 2.5 $\log_{10}$ reduction of *E. coli* O157:H7	Beauchat (1999)
Chlorine dioxide	0.62 and 1.24 g/L	3.0 to 6.0 $\log_{10}$ reduction of E. coli O157:H7	Han and others (2000)
Produce wash	5 sprays of 4.4 to 4.8 ml and 30 s rubbing	Reduced *Salmonella* approx. 4.6 $\log_{10}$ cfu/mL	Harris and others (1999)
Bacteriophage cocktail	25 μL to contaminated wounds	Reduced *Salmonella* approx. 3 $\log_{10}$ cfu/mL	Leverentz and others (2001)

FDA Statement on Foodborne E. coli O157:H7 Outbreak in Spinach

http://www.fda.gov/bbs/topics/NEWS/2006/NEW01466.html
FOR IMMEDIATE RELEASE P06-146 September 26, 2006
Update
To date, 183 cases of illness due to E. coli O157:H7 infection have been reported to the Centers for Disease Control and Prevention (CDC), including 29 cases of Hemolytic Uremic Syndrome (HUS), 95 hospitalizations and one death.

FDA is working closely with CDC and the state of California. FDA has determined that the spinach implicated in the outbreak was grown in three California counties: Monterey, San Benito, and Santa Clara. Spinach grown in the rest of the United States has not been implicated in the current E. coli O157:H7 outbreak. The public can be confident that spinach grown in the non-implicated areas can be consumed.

Consumers are advised not to purchase or consume fresh spinach if they cannot verify that it was grown in areas other than the three California counties implicated in the outbreak.

Other produce grown in these counties is not implicated in this outbreak. Processed spinach (e.g., frozen and canned spinach) is also not implicated in this outbreak.

Industry is working to get spinach from areas not implicated in the current E. coli O157:H7 outbreak back on the market.

Investigators from FDA, CDC and the state of California are working to narrow the area implicated in the current E. coli O157:H7 outbreak even further.

States Affected; Canadian case identified

The 26 affected states are: Arizona (7), California (1), Colorado (1), Connecticut (3) Idaho (4), Illinois (1), Indiana (9), Kentucky (8), Maine (3), Maryland (3), Michigan (4), Minnesota (2), Nebraska (9), Nevada (1), New Mexico (5), New York (11), Ohio (24), Oregon (6), Pennsylvania (8), Tennessee (1), Utah (18), Virginia (2), Washington (3), West Virginia (1), Wisconsin (47), and Wyoming (1).

In addition, Canada has confirmed that one case of E. coli O157:H7 has been positively matched to the outbreak strain in a person who ate bagged spinach.

Laboratory Findings

The Pennsylvania Department of Health has confirmed that the strain of E. coli O157:H7 connected with the outbreak has been isolated from a bag of Dole baby spinach in that state.

The Utah Department of Health (UDOH) and the Salt Lake Valley Health Department (SLVHD) have confirmed that E. coli O157:H7, the same strain as that associated with the outbreak, has been found in a bag of Dole baby spinach purchased in Utah with a use by date of August 30, 2006. Laboratory tests were conducted by the Utah Public Health Laboratory (UPHL).

The New Mexico Department of Health announced on September 20, 2006, that it had linked a sample from a package of spinach with the outbreak strain of E. coli O157:H7. The spinach was eaten by one of New Mexico's patients before becoming sick. DNA fingerprinting tests determined that the strain from the spinach matches the strain from patients in the outbreak. The package of spinach that tested positive was "Dole Baby Spinach, Best if Used by August 30."

Five (5) Recalls

http://www.fda.gov/bbs/topics/NEWS/2006/NEW01466.html
Go to the actual news release (URL listed above) for a complete list of

recalled products by company and product type.

Lettuce Safety Initiative

The FDA developed the Lettuce Safety Initiative **www.cfsan.fda.gov/~dms/lettsafe.html** in response to recurring outbreaks of E. coli O157:H7 in lettuce. As a result of this outbreak, the initiative has been expanded to cover spinach. The objectives of the Lettuce Safety Initiative are as follows:
Assess current industry approaches and actions to address the issue of improving lettuce safety. If appropriate, stimulate segments of the industry to further advance efforts in addressing all aspects of improving lettuce safety.
Alert consumers early and respond rapidly in the event of an outbreak.
Document observations that identify practices that potentially lead to product contamination. Then, develop and/or refine guidance and policy that will minimize opportunities for future outbreaks and/or identify research needs.
Consider regulatory action, as appropriate, based on conditions and practices that could lead to, or spread contamination, or when lettuce has been adulterated.

This initiative is based on the 2004 Produce Safety Action Plan, intended to minimize the incidence of food borne illness associated with the consumption of fresh produce.
FDA continues to work closely with the CDC and state and local agencies to determine the cause and scope of the E. coli 0157:H7 outbreak in spinach. Please check www.fda.gov for updates.

Produce Safety From Production to Consumption: 2004 Action Plan to Minimize Foodborne Illness Associated with Fresh Produce Consumption

The complete action plan can be read at:

http://www.cfsan.fda.gov/~dms/prodpla2.html

Goal and Objectives of the Produce Safety Action Plan (Action Plan):
The overarching goal of FDA's Action Plan is to minimize the incidence of foodborne illness associated with the consumption of fresh produce. To achieve this goal, the Action Plan has four general objectives:
1) Prevent Contamination of Fresh Produce with Pathogens;
2) Minimize the Public Health Impact When Contamination of Fresh Produce Occurs;
3) Improve Communication with Producers, Preparers, and Consumers about Fresh Produce; and
4) Facilitate and Support Research Relevant to Fresh Produce. For each objective, FDA's Action Plan identifies steps that could contribute to the achievement of the objective.

FDA believes that the most effective strategy for reducing foodborne illness from fresh produce is one that approaches the problem from several different angles. For this reason, the Action Plan anticipates that FDA's food safety partners in both the public and private sectors will participate in the identified activities. By working both independently and cooperatively, these agencies or groups will ensure maximum progress toward the goal of reducing the incidence of foodborne illness associated with the consumption of fresh produce.

Crop Report by Brad Bergefurd

Southwest OH

Pumpkin, gourds, Indian Corn and winter squash harvest continues between rains and muddy field conditions. Some areas in SW Ohio have experienced over 15 inches of rain in the past 6 weeks. Fusarium rot and phytophthora rot is being found in pumpkin and winter squash fields. Planting of rye and wheat cover crops continues. Fall herbicide applications are being made to fallow fields. Plasticulture strawberry crops are all planted and are looking and growing well. Harvest of bell pepper, sweet corn, tomato, summer squash, cucumbers, watermelon, eggplant, snap beans, onions, fall red raspberries continues and is nearing the end of the harvest season. Harvest of fall broccoli and cauliflower has begun.