Case Studies in Foodborne Illness in Florida from Fresh Produce

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Research on consumer knowledge and awareness of foodborne illness has shown that consumers do not fully understand principles of food hygiene and hazards of food contamination (Altekruse et al., 1996). High-risk practices, such as the consumption of raw or lightly cooked animal proteins (e.g., eggs, hamburger, shellfish) are fairly common (Klontz et al., 1995), and perceptions and recognition of foodborne illness when it does occur are incorrect (Fein et al., 1995). While documented research on consumer knowledge, perception, and practice of food hygiene touches primarily on common vehicles such as animal proteins, consumers appear to be even less aware of the hazards of foodborne pathogens associated with fresh produce. Consumer demand, changes in the produce industry as a result of food consumption patterns, and social demographics are changing the

patterns of food consumption, food hygiene, and foodborne illness (Beuchat and Ryu, 1997). Numerous outbreaks of foodborne diseases and pathogens have been associated with fresh produce. Some documented incidents are briefly outlined in Table 1.

Since 1994, the State of Florida has been examining food- and waterborne illness outbreaks with the help of nine strategically placed "regional epidemiologists," each of whom covers several of Florida's 67 counties. The additional surveillance and enhanced technical capabilities of the county health departments have dramatically increased the number of foodborne outbreaks reported statewide (Table 2). Some of these Florida outbreaks have been linked to fresh produce, including *Salmonella* in fresh-squeezed, unpasteurized orange [*Citrus sinensis* (L.) Osbeck] juice, *Cyclospora* in fresh red raspberries (*Rubus ideaus* L.) imported from Guatemala, *Cyclospora* in mesclun lettuce (*Lactuca sativa* L.), and Norwalk virus in tossed salad or fruit salad. These outbreaks are briefly described below.

Salmonella has 1600+ serotypes, of which the most common are *Salmonella enteritidis* and *Salmonella typhimurium*. The usual incubation period is 12 to 36 h, but can range from 6 to 72 h. Symptoms are

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Table 1. Summary of documented outbreaks associated with fresh produce prior to 1995.²

Pathogen	Fresh produce vehicle	Location
<i>Shigella</i> species		
<i>S. sonnei</i>	Lettuce from salad bars	Texas
<i>S. sonnei</i>	Shredded lettuce	Texas
<i>S. sonnei</i>	Lettuce	Norway, Sweden, U.K.
<i>Salmonella</i> species		
<i>S. flexneri</i>	Green onions	Midwest U.S.
<i>(Allium cepa</i> L.)		
<i>S. javiana</i>	Raw tomatoes	Multistate
<i>S. montivideo</i>	Raw tomatoes	Multistate
<i>S. saint-paul</i>	Raw bean sprouts	U.K.
<i>(Phaseolus</i> sp.)		
<i>S. saint-paul</i> , <i>S. havana</i> , <i>S. muenchen</i>	Bean sprouts	Sweden
<i>S. gold-coast</i>	Mustard cress	National increase in cases of <i>Salmonella</i>
<i>S. miami</i> , <i>S. bareilly</i>	Pre-cut watermelon [<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nak.]	
<i>S. oranienburg</i> , <i>S. javiana</i>	Watermelon	
<i>S. chester</i>	Cantaloupe on salad bars	Multistate
<i>S. poona</i>	Cantaloupe on salad bars	Multistate and Canada
<i>Escherichia</i> species		
<i>E. coli</i> (Enterotoxigenic)	Salads containing raw vegetables; garden salad (iceberg, romaine, endive, shredded carrots)	U.S. airline passengers
	Tossed salad [onions, carrots, zucchini (<i>Cucurbita</i> sp.), peppers (<i>Capsicum annuum</i> L.), broccoli, mushrooms, tomatoes]	U.S.
<i>E. coli</i> 0157:H7 (Enterohemorrhagic)	Unpasteurized apple cider; cantaloupe (<i>Cucumis melo</i> L., Cantalupensis group)	Oregon
	Raw broccoli and other salad bar items	Texas
<i>Other pathogens and diseases</i>		
<i>Listeria monocytogenes</i>	Raw celery, tomatoes, lettuce	Boston
	Coleslaw (<i>Brassica oleracea</i> L., Capitata group)	Maritime provinces, Canada
<i>Bacillus cereus</i>	Homegrown raw vegetable seed sprouts	U.S.
Viral gastroenteritis	Salads and other ready-to-eat items	Various states
Hepatitis A	Frozen raspberries (in raspberry mousse)	Scotland
	Frozen strawberries	Multistate
	Commercially distributed lettuce	Kentucky
	Uncooked, diced tomatoes	Arkansas

²From Beuchat, 1996.

Table 2. Summary of foodborne illness outbreaks reported from Florida between 1989 and 1997.^a

Year	No. of outbreaks	No. of cases
1989	11	72
1990	7	314
1991	17	331
1992	40	1048
1993	136	890
1994	258	1526
1995	296	2908
1996	305	2777
1997	439	2744

^aFlorida Dept. of Health, Bureau of Environmental Epidemiology, Foodborne Illness Surveillance and Investigation, Annu. Rpt., Florida 1997.

expressed by the sudden onset of a headache, followed by abdominal pain, diarrhea, and sometimes vomiting, with fever almost always present. Dehydration is a danger in infants and the elderly. The duration of the illness is usually several days (Benenson, 1995; Bryan, 1982; U.S. Food and Drug Administration, 1992). *Salmonella hartford* and *S. gaminara* have been isolated from chickens, pigs, reptiles, birds, bovines, and the environment.

SALMONELLA AND NONPASTEURIZED ORANGE JUICE

In June 1995, the New Jersey Dept. of Health notified the State of Florida of eight cases (people) of *Salmonella hartford*, a relatively rare serotype. The only common experience identified at this point was visits by infected persons from New Jersey to a popular Orange County theme park. However, no particular resort hotel, restaurant, or tourist attraction was associated with illness. Sixty-three cases from 29 states were eventually identified. Of these, 52 were laboratory-confirmed. One person had both *Salmonella hartford* and *Salmonella gaminara*.

The only meals associated with the illness were the so-called "character breakfasts" (breakfasts with cartoon characters), but no single breakfast or breakfast location was associated with illness. Animal exposures were determined to be minimal and were not associated with the illness. A confirmed case is defined as a laboratory confirmation of *Salmonella hartford* from stool or blood from a visitor or resident of the Orlando area since 1 May 1995. A probable case is defined as a laboratory confirmation of *Salmonella* group C1 from stool or blood from a visitor to or resident of the Orlando area since 1 May 1995. The median age of affected people was 12 (range 1–63) years. The median duration of illness was 7 d (range 3–23 d).

A case-control study showed that 97% of affected people had consumed fresh-squeezed nonpasteurized orange juice from a single producer, who supplied 100% of this beverage served at the character breakfasts and 88% of that served at the theme park. Orange juice is generally thought to be unable to harbor or support the growth of bacteria. However, *Salmonella* bacteria can survive in orange juice with a pH of 3.0 to 3.1 at 5 °C for up to 27 d. Outbreaks of *Salmonella typhii* have also been linked to orange juice.

The production of fresh-squeezed orange juice began with a potable water rinse/spray of oranges, then an additional chlorine spray/rinse, followed by an anionic rinse/spray of oranges. Oranges were then squeezed, and the juice was run through a surge tank and subsequently chilled (1 to 3 °C) and stored (0 °C). The maximum time from squeezing to bottling was 24 h, and the juice had a 17-d shelf life. Numerous unrelated groves supplied the oranges. While chicken manure could be considered to be a source of *Salmonella*, it was not used as a fertilizer in any of the groves from which the implicated oranges were harvested. Environmental factors that may have influenced this outbreak include inadequate processing plant integrity and sanitation, insufficient sanitation of oranges, or a combination of these factors.

Ten of 12 production runs at the implicated plant in June and July produced 10 of the 12 orange juice samples positive for *Salmonella gaminara* and all 12 samples positive for *Escherichia coli*. These findings would indicate an ongoing contamination problem. A Univ. of Florida researcher also found *Salmonella hartford* in toads (*Bufo*

terrestins) and *Samonella newport* from tree frogs (*Hyla cinera*) found near the plant. Although there is no way to determine whether the frogs and toads were the culprits, the plant did have holes near the roof line and other unprotected areas where they could have entered (Jackson, 1997).

The outbreak appeared to have been limited to those visitors exposed during the last 2 weeks of May. All juice product from the plant was recalled and the plant voluntarily closed, once nonpasteurized orange juice was identified as the possible vehicle. The theme park immediately switched to serving pasteurized orange juice.

One hypothesis regarding the circumstances associated with this outbreak is that disease-causing microorganisms could have been in the fresh-squeezed, nonpasteurized juice prior to this outbreak, but at a level below the pathogenic threshold or causing only mild gastrointestinal illness. This situation might have been followed by the introduction of *Salmonella hartford* into the plant, via oranges or equipment contamination, causing severe illness that required medical treatment and detection by state and national surveillance networks.

The market for fresh-squeezed, nonpasteurized orange juice has developed in response to "back to nature" movements and the desire for "natural" and "fresh" foods. Without pasteurization, the presence (or absence) of pathogenic organisms on oranges or equipment can be critical for the production of a safe product. Recommendations resulting from the investigation of this outbreak included the consideration of pasteurization of orange juice, effective sanitation of oranges prior to squeezing, and routine analysis of nonpasteurized, fresh-squeezed juices to assure efficacy of sanitation practices and production processes.

In response to the conclusions and recommendations of this investigation, the State of Florida Dept. of Citrus promulgated more stringent sanitation requirements for nonpasteurized citrus juices. These include the exclusive use of high-grade fruit with strict sanitation requirements for both fruit and processing equipment, design of buildings to exclude environmental contaminants and vermin, and the development of microbiological standards and indicator organisms for the finished product with a quality control system (Chapter 20-64.020, Florida Administrative Code).

CYCLOSPORA AND FRESH RED GUATEMALAN RASPBERRIES, 1996

One of the emerging pathogens of the 1990s, *Cyclospora* is a one-celled parasite that causes prolonged and often intermittent diarrhea. The average incubation period is ≈1 week (range 1–11 d). *Cyclospora* oocysts are about twice the size of *Cryptosporidium* oocysts and are often confused with them by the untrained laboratory analyst. Direct person-to-person transmission is thought to be unlikely and has not yet been documented.

From 15 Apr. to 17 Aug., a total of 179 laboratory-confirmed cases of cyclosporiasis were reported. Seventy-three percent of the cases occurred in residents of Palm Beach and Broward Counties, 61.5% of the cases were female, and all but 17 confirmed cases were sporadic. Nine clusters of cyclosporiasis were identified, including 17 confirmed and 42 probable cases. Of these, eight were linked to meals eaten in private residences, and one to a catered event. The only food common to these nine events was raspberries, mostly eaten in mixtures with other berries, especially strawberries (*Fragaria x ananassa* Duch.). Guatemala was the source of the raspberries for six of the events, one event could have been associated with either Guatemalan or Chilean raspberries, and the other two sources could not be conclusively traced (Table 3; Dolores Katz, Bureau of Epidemiology, Florida Dept. of Health, personal communication).

This statewide investigation is associated with a nationwide investigation in which 1465 cases of cyclosporiasis (978 laboratory-confirmed, 487 probable) were reported by 20 states, the District of Columbia, and two Canadian provinces. A total of 725 confirmed and probable cases were associated with 55 events. Raspberries were served at 50 of these events, and may have been served at four others. Adequate data were available for 41 of these events, in 27 of which the association between the consumption of raspberries and cyclosporiasis was statistically significant ($P \leq 0.05$). After extensive traceback

Table 3. Summary of *Cyclospora* clusters with Guatemalan raspberries as source, 1996.^z

Date	Cluster size (no.)	People ill (no.)	Confirmation ^y (no.)
5 May	12	8	1
12 May ^x	6	4	3
12 May	6	5	2
21 May ^w	5	2	2
29 May	9	5	3
8 June	11	9	3
14 June	3	3	1

^zFrom D. Katz, Bureau of Epidemiology, Florida Dept. of Health, (personal communication).

^yConfirmed to be *Cyclospora* involved by laboratory isolation and symptom expressions.

^xRaspberry dessert.

^wSource unknown.

efforts, investigators were able to conclude that for 29 events, the raspberries had come from Guatemala (21 definite events; eight possible events). As few as five farms in Guatemala may have accounted for 25 events, but the mode of contamination of the raspberries remains unclear (Herwaldt et al., 1997).

Cyclosporiasis became a notifiable disease in the State of Florida on 21 July 1996. In 1997, additional cases of cyclosporiasis associated with imported Guatemalan raspberries were reported in other states, but Florida recorded only sporadic cases (U.S. Centers for Disease Control and Prevention, 1997a, 1997b). However, in April and in Dec. 1997, two outbreaks of cyclosporiasis in Florida were linked to the consumption of mesclun lettuce (discussed separately below). From 15 Mar. through 15 Aug. 1998, fresh red raspberries were not allowed entry into the United States by the Food and Drug Administration (Fred R. Shank, Director, and Janice F. Oliver, Deputy Director for Systems and Support, Center for Food Safety and Applied Nutrition, personal communication; U.S. Food and Drug Administration Import Alert, IA #20-04, 24 Apr. 1998). As of 11 Aug. 1998, only four cases of cyclosporiasis had been recorded in Florida, all of them sporadic.

CYCLOSPORA AND MESCLUN LETTUCE, LEON COUNTY, 1997

On 15 Apr. 1997, a private lab in Tallahassee reported two cases of cyclosporiasis. The Dept. of Health's Bureau of Laboratories in Jacksonville later confirmed the cases. A preliminary investigation indicated that in both cases, victims had eaten at the same restaurant in Tallahassee. Because of the emerging nature of this pathogen, the U.S. Bureau of Environmental Epidemiology requested epidemiologic assistance from the U.S. Centers for Disease Control and Prevention on 20 Apr. 1997. On 19 Mar., the day implicated by the initial questionnaire, the restaurant served ≈243 persons, of whom 142 charged their meals. Of the 142 persons in the charge-card group, 89 (62.7%) were interviewed. A retrospective cohort study using charge-card receipts was initiated with 75 of these people. The case definition consisted of:

- laboratory-confirmed: (plus one gastrointestinal symptom) *Cyclospora* isolation;
- probable: diarrhea (≥ three loose stools in a 24-h period) for ±3 d; and
- possible *Cyclospora* involvement: (≥ five symptoms including a gastrointestinal symptom).

Twenty-nine of the 75 persons in the study met the case definition. The group had a median age of 44 years; 62.7% were female. The onset of illness occurred a median of 8 d (range 0–14 d) after eating lunch at the restaurant.

Analytical epidemiology indicated that the consumption of mesclun greens was correlated with cyclosporiasis. People who ate the mesclun were five to eight times as likely to get cyclosporiasis as those who did not (calculated as relative risk with a confidence interval of 2.8 to 25.7, $P \leq 0.001$). The traceback indicated that the mesclun originated from either a domestic farm or one of two farms in Peru. The local wholesaler was not able to state conclusively the source of the mesclun greens consumed at the local restaurant on the day of the outbreak

(Florida Dept. of Health, Foodborne Illness Surveillance and Investigation, Annual Report, 1997).

HOLIDAY DINNER CYCLOSPORA, ORANGE COUNTY, DEC. 1997

During the last days of 1997 and the first months of 1998, the Orange County Health Dept. of the Florida Dept. of Health investigated a multistate *Cyclospora* outbreak associated with a tourist attraction in central Florida. Initial information disclosed four cases of presumed *Cyclospora* infection among ≈20 persons in a group who traveled to the Orlando area from New York and Pennsylvania from 27 Nov. to 12 Dec. Several other people in this party were also reported to be ill. Nationwide case finding and surveillance efforts expanded the cohort to 38 people, of whom 12 had reported illness compatible with *Cyclospora* infection, and eight had laboratory-confirmed positive stools for *Cyclospora*. The cohort was comprised of four distinct groups of people. Group one consisted of 20 people from New York and Pennsylvania with eight illnesses. Group two consisted of nine people from New York and North Carolina, with two ill. The third group, from New York, had five people, one ill. The fourth group, from New Hampshire and Massachusetts, consisted of four people with one ill. None of the people in any of the four groups knew each other or had any other epidemiological associations.

The epidemiological investigation of these 38 people showed that 100% had consumed food at a dinner show located at a convention center in central Florida on 3 Dec. 1997. This dinner show was a temporary holiday event that served 400–700 people twice each night, and ran from 1–24 Dec. 1997. The meals were prepared in the convention center food service facility. Food items served included a relish tray of cauliflower (*Brassica oleracea* L., Capitata group), broccoli (*B. oleracea*, Botrytis group), carrots (*Daucus carota* L.), and celery [*Apium graveolens* L. var. *dulce* (Mill.) Pers.] with white creamy dressing or an apple (*Malus ×domestica* Borkh.) vinaigrette dressing. Dessert was a Yule log (a thin cake and frosting roll) or a raspberry, strawberry, or melon (*Cucumis melo* L.) fruit cup. The Yule log was offered to everybody. Apparently the fruit cups were offered to those who requested something other than the Yule log. The type of fruit cup offered depended on the time of night. A leafy green salad was also served consisting of romaine lettuce (broken into bite-size pieces), baby lettuce greens (spring mix, also known as mesclun lettuce), dried apricots (*Prunus armeniaca* L.), dried cherries (*Prunus* sp.), and raisins (*Vitis* sp.), with cherry tomatoes on the side.

Statistical analysis disclosed a significant association between consumption of the salad and the *Cyclospora*-related illness (OR = undefined; uncorrected chi square = 15.20 ($P = 0.000096$)). An on-site investigation of the food service facility disclosed that the romaine lettuce was not added to the salad until 6 Dec. 1997 in order to boost the volume. The dried fruit was consumed by only two of the ill people and was not considered to be significant. Since previous *Cyclospora* outbreaks earlier in 1997 had implicated mesclun lettuce as a vehicle, the spring mix or baby lettuce greens became the focus of traceback activities. Preliminary information from the traceback disclosed a single distributor who supplied the warehouse servicing the convention center. This distributor, located in north Florida, was also a grower of spring mix lettuce. This distributor/grower also obtained spring mixes from two other distributors during the 10 d prior to the 3 Dec. exposure period. As of this writing, information pertaining to the origins of spring mixes served at the 3 Dec. event is inconclusive (Florida Dept. of Health, Foodborne Illness Surveillance and Investigation, Annual Report, 1997).

NORWALK VIRUS IN GARDEN AND FRUIT SALAD, 1996–97

While foodborne pathogens can be introduced in the growing/harvesting and production processes, an outbreak caused by circumstances during the food preparation process is not uncommon. In this case, Norwalk virus was traced to garden salad and fruit salad in four serial outbreaks that occurred in the same restaurant in less than a year.

Norwalk and other small, round, structured viruses (Hawaii, Snow

Mountain, Taunton, and Caliciviruses) have an incubation period of 24 to 48 h (median 36 h). Symptoms include nausea, vomiting, diarrhea, abdominal pain, myalgia, headache, malaise, and low-grade fever, and last 24 to 48 h. The mode of transmission is fecal-oral, aerosolization (of vomit), food, and water. Causal factors include inadequate sewage disposal and use of contaminated water.

These outbreaks are significant in that the same scenario was repeated four times in the same country club restaurant. The first three times (in 1996), garden salad was implicated as the vehicle of transmission; the last time (in 1997), fruit salad was identified as the vehicle. Forty-one, 50, 26, and 10 people, respectively, became ill. The hypothesis is that a sick food handler worked with the implicated food items and transmitted the illness to the restaurant patrons. These outbreaks were further complicated in that the restaurant owners/operators denied their involvement in or connection with any of the outbreaks. The issue of sick food handlers continuing to work with food is an ongoing struggle, as they usually are not paid when they are not present, and they can be fired for not coming to work. Providing worker's compensation for sick food handlers has been suggested, but this is not common in the food industry.

CONCLUSION

Where does the public health responsibility lie? There is accountability at all stages of the process from produce growing to food preparation. Preparation practices can be affected at home as well as in public food service establishments. Growers can prevent pathogens from contaminating fresh produce through safe growing practices, including the use of potable water and appropriate fertilizers and pesticides. Growers also need to provide sanitary facilities for harvesters with adequate field toilets and accompanying handwashing facilities. Processors should follow the same principles, using safe processing practices in clean, sanitary facilities and processes and obtaining their produce from safe food sources. Food service establishments, including restaurants, caterers, grocery stores, and private homes, should also obtain their produce from approved food sources while using safe food-handling practices, including appropriate shelf life and temperature control, avoidance of cross-contamination, and good personal hygiene, especially proper handwashing techniques (United

Fresh Fruit and Vegetable Association, Industrywide Guidance to Minimize Microbiological Food Safety Risks for Produce, n.d.). The food service industry constantly struggles with the issue of sick food handlers continuing to work with food. This is a problem for which there is no easy solution. With the safe practices described above at all levels of production, from field to fork, many foodborne outbreaks in fresh produce can be avoided.

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