

CONCISE COMMUNICATIONS

An Outbreak of *Salmonella* Serogroup Saphra Due to Cantaloupes from Mexico

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An outbreak of *Salmonella* serogroup Saphra (*S. saphra*) infections was studied by laboratory-based surveillance, case-control and trace-back studies, and a survey of cantaloupe preparation practices. Twenty-four patients with *S. saphra* infections had illness onsets between 23 February and 15 May 1997; 75% were ≤ 6 years old; 23% were hospitalized. Case patients were more likely than controls to have consumed cantaloupe (88% vs. 45%; matched odds ratio [MOR], 15.5; 95% confidence interval [CI], 1.7–139) and pre-cut cantaloupe (59% vs. 19%; MOR, 14.5; 95% CI, 1.6–128). The trace-back study identified 1 growing region in Mexico as the source of cantaloupes for 95% of the patients who ate cantaloupes. Only 17% of case patients washed cantaloupes before cutting them. This outbreak is another example of gastrointestinal disease in the United States associated with imported contaminated produce. Consumers and retailers should wash cantaloupes before cutting them; there should be international efforts to ensure food safety.

Outbreaks of salmonellosis have been associated with fresh produce [1], but melons have rarely been implicated. Three recorded salmonellosis outbreaks were associated with watermelon [2, 3] and 3 with cantaloupe [4–6]. Cantaloupes from Mexico were implicated in an outbreak of *Salmonella chester* [4], and cantaloupes from Texas were implicated in an outbreak of *S. poona* [5]; no common supplier of cantaloupes was identified for an outbreak of *S. oranienburg* [6]. Here we describe a 1997 outbreak of salmonellosis among California residents that was associated with *Salmonella* serogroup Saphra (*S. saphra*) and the epidemiologic investigation.

Methods

Surveillance. The California Department of Health Service's Microbial Diseases Laboratory (MDL) either serotypes or receives serotyping results of all *Salmonella* isolates identified in California. Only 10 cases of *S. saphra* were identified in California in the 24-year period 1973–1996; however, in March 1997, 15 cases were reported within 3 weeks among persons who resided in 12 counties throughout California. To determine whether the outbreak in-

involved residents of other states, we contacted the Centers for Disease Control and Prevention (CDC).

To identify an outbreak strain, we used pulsed-field gel electrophoresis (PFGE) to characterize isolates from all patients with *S. saphra* in 1997 and compared them with background strains maintained at the MDL. We collected demographic, clinical, and epidemiologic data from all patients with the outbreak strain.

Case-control study. To determine the cause of the outbreak, we conducted a case-control study. Case patients were the first 18 patients with primary infections identified with the outbreak strain. Controls were age- and neighborhood-matched to case patients. Age matches in children were 6 months–2 years or 3–6 years. Adult controls were matched within 10 years of the case patient's age. To identify controls, case patients or their parents were asked to name persons in their neighborhood who were in the same age group as the patient. For patients who could not identify an appropriate neighborhood control, we obtained controls from their physicians or from neighborhood child care centers (when case patients were young children).

All interviews were conducted by telephone. To generate hypotheses of possible food-borne sources, we conducted in-depth interviews with 8 case patients (or their parents). We prompted recall about foods consumed in the week before diagnosis by using a list of >65 food items. The final 24–food item questionnaire included all foods listed by $\geq 50\%$ of the patients who participated in the hypothesis-generating questionnaire. We asked cases about foods consumed in the week before their illness onset and controls about foods consumed in March 1997. Matched odds ratios (MORs), 95% confidence intervals, and Mantel-Haenszel *P* values were calculated by use of the software package Epi Info [7]. For selected associations, we conducted stratified analyses.

Trace-back and trace-forward investigations. We interviewed all patients with the outbreak strain (including those who were iden-

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tified after the case-control study was completed) about the retail or restaurant source of cantaloupes consumed in the week prior to illness onset. We reviewed invoices from these grocery stores and restaurants and reviewed records from their distributors. To account for variable incubation periods and shelf life of cantaloupes, we included all distributors that supplied stores and restaurants in the 2 weeks before the illness onset of each case patient who reported eating cantaloupe. We reviewed the distribution of cantaloupes from the implicated distributor during the outbreak period (a trace-forward investigation).

Cantaloupe handling survey. We surveyed case patients (or their parents, when case patients were children) who bought cantaloupes from a grocery store about how cantaloupes were displayed at the store and the handling and refrigeration of cantaloupes at home.

Results

We identified 25 California residents infected with *S. saprophytica* infections with specimens collected in 1997. Twenty-four patient isolates had identical PFGE patterns (the outbreak strain). The PFGE pattern of the outbreak strain was distinct from that of all 5 *S. saprophytica* strains from prior years in California. The dates of onset of illness for patients infected with the outbreak strain ranged from 23 February to 15 May 1997; 63% had illness onset within a 3-week period (2–22 March 1997). Between January and May 1997, no other state had >1 case of *S. saprophytica* (CDC, unpublished data).

The median age of patients infected with the outbreak strain was 3 years (range, 4 months–81 years); 18 (75%) were age ≤6 years. Among the 6 patients age >6 years, 5 (83%) had underlying medical conditions. The race/ethnicity and county of residence of patients reflected the California population. All patients had diarrhea (median, 6 days; range, 3–30), 58% had bloody diarrhea, and 90% had fever; 17% were hospitalized (median, 5 days; range, 2–14). There were no deaths.

In the case-control study, case patients were more likely than their matched controls to recall eating cantaloupe (88% vs. 45%; MOR, 15.5; table 1). Of case patients who ate cantaloupe, 8 ate precut cantaloupe only, 5 ate cantaloupe sliced at home only, and 2 ate both types. Patients were more likely than controls to report eating cantaloupe that was precut prior to purchase from a grocery store or was served cut in a salad bar or as a garnish (59% vs. 19%; MOR, 14.5). In limiting the analysis to participants who did not eat precut cantaloupe (but maintaining the match), there was a trend toward an association between eating cantaloupe sliced at home and illness ($P = .06$). Patients were less likely than controls to have eaten raw carrots (17% vs. 83%; MOR, 0.13). Carrots remained protective even after controlling for age and cantaloupe consumption. No other food items were associated with or protective of *S. saprophytica* infection.

Of the 15 case patients who reported eating cantaloupe, 9 had purchased cantaloupes from grocery stores, 3 ate cantaloupe at a restaurant, and 3 had both exposures. Of the 12 who

Table 1. Significant associations in a case-control study of an outbreak of *Salmonella* serogroup Saphra, in California, 1997.

Food	No. (%)		Matched odds ratio	95% confidence interval	Mantel-Haenszel P value
	Case patients	Controls			
Cantaloupe	15 (88)	14 (45)	15.5	1.7–139	.002
Precut cantaloupe	10 (59)	6 (19)	14.5	1.6–128	.003
Raw carrots	4 (17)	20 (83)	0.13	0.03–0.70	.03

bought cantaloupes from grocery stores, 11 provided information about cantaloupe handling. Six bought whole cantaloupes, and 5 purchased precut cantaloupe. All 6 who bought whole cantaloupes reported that cantaloupes were both displayed in the store and stored at their home at room temperature; only 1 (17%) washed the cantaloupe prior to cutting, and, after cutting the cantaloupe, all 6 refrigerated the cantaloupe pieces for 1–4 days. Of the 5 persons who bought precut cantaloupe, 4 reported that the cantaloupe pieces were on ice in the store and 1 that the pieces were refrigerated; 3 cantaloupes were precut in small pieces without the rind, and 2 were precut in large pieces with the rind intact. All patients or parents reported refrigeration of precut cantaloupe at home. Two parents reported that their children chewed on the cantaloupe rind.

Cantaloupe consumption was reported by 21 (88%) of the 24 patients with the outbreak strain. Twenty patients (95% of those who ate cantaloupes) ate cantaloupes from restaurants and grocery stores that received cantaloupes from distributor A, located in Southern California. During March 1997, distributor A shipped cantaloupes only to California. The sole source of cantaloupes for distributor A was a packer in Altamirano, Guerrero State, Mexico. One patient ate cantaloupe not supplied by distributor A; however, the cantaloupes were supplied by distributors who received cantaloupes from the same Mexican region (Altamirano). During the outbreak period, cantaloupes were imported to California from at least 4 other Mexico states and from at least 6 other countries. The outbreak ended in May, when domestic cantaloupes replaced imported cantaloupes.

Discussion

This outbreak of salmonellosis was due to the unusual serotype Saphra and was transmitted by an unusual vehicle, cantaloupes. Laboratory-based surveillance, serotyping of all *Salmonella* isolates, and the unusual serotype facilitated detection of the outbreak. Although only 24 culture-confirmed patients were identified, the true extent of the outbreak could be >480 infected persons, since <5% of *Salmonella* cases are reported in the United States [8]. Both our epidemiologic and trace-back studies support our conclusion that cantaloupes imported from a specific region in Mexico were responsible for the outbreak.

The epidemiologic study is notable for a high proportion of patients who recalled eating cantaloupe (88%), compared with

other cantaloupe-associated outbreaks (44%–62%) [4, 5]. Most of the patients in our outbreak were young children who generally have more limited food preferences than adults; this probably facilitated recall of food histories by their parents. Also of note was the finding of a protective effect of eating raw carrots; 6-methoxymellein accumulates in carrot roots and inhibits the growth of several species of bacteria, including *Salmonella* [9]. That our trace-back investigation identified 1 specific growing region in the southwest of Mexico is remarkable, since, during the outbreak period, California imported cantaloupes from several countries and several states in Mexico.

The cantaloupes consumed by patients probably had low-level contamination with *Salmonella* organisms on their surfaces; melons are grown on the ground where they can be contaminated by rodents, birds, and untreated manure or surface water. Among cantaloupes from Mexico associated with the 1990 *S. chester* outbreak, 1% had surface contamination with salmonellae [4].

To control the surface contamination of cantaloupes, farms implicated in outbreaks could be investigated to identify (and rectify) practices that lead to contamination. Although our findings were presented to the US Food and Drug Administration (FDA), no farm investigations in Mexico were done, so no specific control measures were implemented. While farm investigations for domestically grown produce are standard, investigations of farms outside the United States were not routine at the time of our study.

General control measures recommended by the melon quality program include chlorine rinsing of melons in packing plants, testing of melons received by packing plants, and maintaining records of lot numbers and shipments of melons (unpublished discussion, Melon Quality Program meeting, Dallas, TX, 14 October 1991). The California distributor implicated in our outbreak shipped cantaloupes in their original packages (from Mexico), so there was no handling, repackaging, rinsing, or testing of melons. Although there were no lot numbers, the cantaloupes could be traced through purchase order numbers.

In 1997, the Western Growers Association and the International Fresh-Cut Produce Association produced voluntary guidelines for fresh-cut produce [10]. In June 1998, a memorandum of understanding to enhance food safety was signed by the secretaries of agriculture and health from the United States and Mexico, and, in October 1998, the FDA issued a guide for minimizing microbial safety hazards in fresh fruits and vegetables.

To reduce surface and internal contamination of cantaloupes at the retail level, in 1991 the FDA advised food retailers to wash melons before cutting, to remove rinds from cut melons, to maintain cut melons at <7.2°C after cutting, and not to display unrefrigerated cut melons for >2 h after cutting [11]. Our small survey of patients suggests a prevalent practice of displaying cut cantaloupe on ice in grocery stores; unlike refrigeration, ice cannot be relied on to maintain an internal

temperature of <7.2°C in cantaloupe meat. Another method for eliminating contamination that merits serious consideration is γ -irradiation [12].

Previous investigations of salmonellosis associated with cantaloupe stressed an association with precut cantaloupe [4, 5]. The flesh of cantaloupes can be contaminated when cutting through a contaminated rind. Then, if the cut pieces are held for several hours to days at suboptimal “warm” temperatures, there may be growth of salmonellae. Although we found a strong association with precut cantaloupe, ≥ 5 patients were infected after eating cantaloupe that was purchased whole and cut at home. However, since cantaloupes cut at home were routinely kept for days in the refrigerator, the pieces consumed by patients may not have been freshly cut. Nevertheless, restaurant-cut cantaloupe probably poses a greater risk than home-cut cantaloupe, because several cantaloupes are generally cut at a time, and 1 contaminated rind can contaminate the meat of several others.

While awaiting better decontamination of melon surfaces, consumers, retailers, and food service establishments should be reminded to wash melons in hot soapy water followed by a rinse before cutting to decrease the risk of salmonellosis, especially among immunocompromised persons, the old, and the young.

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