Research Note

Two Outbreaks of *Salmonella enteritidis* Associated with Monte Cristo Sandwiches

RENEE RIDZON,1* PATRICIA KLUDT,2 JOSEPH PEPPE,2 KHALIL SHARIFZADEH,2† and SUSAN LETT2

1Division of Field Epidemiology, Epidemic Intelligence Service, Centers for Disease Control and Prevention, 1600 Clifton Rd., Atlanta, Georgia 30333, and 2Massachusetts Department of Public Health, 305 South Street, Boston, Massachusetts 02130, USA

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**ABSTRACT**

We report on two outbreaks of *Salmonella enteritidis* which occurred in 1992; both were associated with Monte Cristo sandwiches. The first outbreak, which occurred in Woods Hole, Massachusetts, was investigated as a case-control study, and involved 74 persons. The second outbreak, investigated as a cohort study, occurred in Brewster, Massachusetts, and involved 32 persons. Monte Cristo sandwiches were strongly implicated in both outbreaks; the odds ratio in the case-control study was 43, and the relative risk in the cohort study was 13. Food-preparation procedures were reviewed and food handlers were educated about safe food-preparation practices. Because of the short grilling time for Monte Cristo sandwiches, (usually several minutes) the eggs used in the preparation may only be partially cooked. As a result, this food should be viewed as high risk for *S. enteritidis*. Pasteurized eggs should be used to prepare Monte Cristo sandwiches, especially in a commercial setting.

Key words: *Salmonella enteritidis*, eggs, Monte Cristo sandwiches

*Salmonella* infections transmitted to humans by contaminated food or by an infected person are one of the major causes of bacterial gastrointestinal illness in the United States (4). Signs and symptoms of salmonellosis (e.g., abdominal pain, diarrhea, and fever), appear from 6 to 72 h after consumption of contaminated food. The infection usually resolves spontaneously and treatment is not required; however, there may be long-term sequelae of infection, such as aseptic arthropathies (10, 12). In some persons (i.e., young children, the elderly, and immunocompromised persons) symptoms can be severe and death may occur.

In the late 1970s and early 1980s reports of *Salmonella enteritidis* (SE) infection increased, especially in the North-eastern United States. Eggs and egg-containing foods were identified as the vehicle in 77% of the outbreaks caused by the organism (11). Since then, intact and sanitized grade A eggs have been recognized as the most important source of SE infection (5). An estimated 0.01% of shell eggs are contaminated with SE (3).

The Monte Cristo sandwich or “fried sandwich” is made of bread, sliced ham, turkey, and cheese; it is dipped in a chicken egg and cream mixture to soak the bread and then grilled and served warm. In 1992, the Massachusetts Department of Public Health (MDPH) Working Group of Food Borne Illness Control investigated six outbreaks of SE to identify implicated foods and food-preparation practices that may have contributed to transmission. In two outbreaks, Monte Cristo sandwiches were strongly associated with SE illness, and food-handling practices were observed which may have contributed to transmission.

**MATERIALS AND METHODS**

*Epidemiologic investigation*

Stool specimens were cultured and isolates identified as *Salmonella* species were sent to MDPH for serotyping by tube agglutination (7). SE isolates were sent to Centers for Disease Control and Prevention (CDC) for phage typing (13).

During outbreak 1, which occurred at a research institute cafeteria, the number of potentially exposed persons was unknown. Self-administered questionnaires were delivered or mailed to all institute enrollees to obtain histories for food eaten at breakfast, lunch, and supper served 6 to 9 July 1992. The questionnaires were also distributed to persons who returned to the cafeteria for later meals, but who may not have been institute enrollees, and to food handlers. Outbreak 2 occurred among attendees of a meeting held at a hotel. Food history questionnaires were distributed to all meeting attendees and food handlers.

In outbreak 1, a clinical case-patient was defined as a person who had eaten or worked at the research institute on 7 to 9 July 1992 and reported diarrhea or the combination of any of three signs or symptoms (i.e., nausea, vomiting, abdominal cramps, fever, chills, or body aches) during 7 to 14 July 1992. A culture-confirmed
case was a person whose stool tested positive for SE and who ate or worked at the institute 7 to 9 July 1992. In outbreak 2, the identical case definitions were used except for the cases of those who worked at or attended the meeting at the hotel, 5 to 6 October 1992. Odds ratios, relative risks, $P$ values, and confidence intervals were calculated using Epi Info version 5 software (6).

Environmental investigation

Environmental investigations consisted of inspection of kitchens and food-preparation practices and temperature monitoring of prepared foods. Hazards analysis critical control point evaluations were conducted (8). Cooks provided detailed descriptions of suspect food preparation.

RESULTS

Outbreak 1, epidemiologic investigation

In outbreak 1, questionnaires were completed by 149 persons. Of the respondents, 47 (31%) met the case definition for salmonellosis; 23 had stool cultures yielding SE, and 24 others had illness that met the clinical case definition (Table 1).

The peak illness onset was 10 July, and consumption of Monte Cristo sandwiches served at the noon meal on July 9 was strongly associated with illness (odds ratio, 43; 95% confidence interval, 12 to 183). The incubation period ranged from 12 to 72 h (mean 34 h) after the implicated meal (Figure 1). In addition to the 47 cases identified in the case control study, another 18 persons with culture-confirmed stools and 9 with symptoms that met the clinical-case definition were examined at the local hospital but did not complete questionnaires, and their food histories were not available. In total, 74 persons were linked to this outbreak; the three SE isolates sent to CDC were all phage type 8.

Outbreak 1, environmental investigation

The day the sandwiches were prepared and served, four dozen eggs were cracked, pooled and stored at 3°C (38°F). The sandwiches were dipped in the pooled eggs, grilled until brown on both sides, and placed in a hot holding pan (63°C [145°F]). The eggs could not be traced back to the original farm(s).

Outbreak 2, epidemiologic investigation

In outbreak 2, questionnaires were distributed to a total of 203 meeting attendees and kitchen staff. A total of 141 (69%) questionnaires were completed and illness was reported by 32 of 141 persons (23%). SE was isolated from the stools of 5 persons. The attack rate was statistically higher among those who ate lunch 6 October 1992. Illness occurred between 6 and 8 October 1992, and had a mean onset 24 h after the implicated meal (Figure 2). Among those who ate Monte Cristo sandwiches, 24 (83%) of 29 persons reported illness compared with 8 (6%) of 133 persons who did not eat the sandwiches (relative risk 14; 95% confidence interval 5 to 42). The three SE isolates submitted all were phage type 14b.

Outbreak 2, environmental investigation

Two days before serving the sandwiches, 30 dozen eggs were cracked and pooled in a container, and stored at 7°C (44°F). One day before serving the sandwiches, the pooled eggs were removed from the refrigerator. They remained at room temperature for 2.5 h; a portion was used, and the remaining eggs were returned to the refrigerator. On the day
the sandwiches were prepared and served, they were dipped in the eggs, grilled for 1 min on each side, and placed in a convection oven for 5 min. The maximum temperature the sandwiches reached during the food grilling process is unknown. The eggs could not be traced to the original farm(s).

**DISCUSSION**

In the two large SE outbreaks reported here, illness was strongly associated with eating Monte Cristo sandwiches in each, and food-preparation practices such as pooling of eggs, allowing pooled egg mixture to stand at room temperature and incomplete cooking of eggs may have contributed to transmission of SE. Foods containing raw eggs (e.g., eggnog, homemade ice cream, hollandaise sauce, and Caesar salad dressing) are known to be high risk for SE. A single *Salmonella*-containing egg may contaminate a pooled egg mixture, resulting in infection if the eggs are used in high-risk foods (9). When mixtures containing contaminated raw or partially cooked eggs stand at room temperature, SE can multiply, and the large number of organisms may not be completely killed by standard cooking methods (1, 2).

*Salmonella* infections are a serious public health problem. Chicken eggs are recognized as a major source of SE. Recommendations to reduce risk of infection include cooking eggs long enough to kill any microorganisms, keeping eggs refrigerated until just before preparation, and using pasteurized eggs product for foods that require pooling of raw eggs (1, 4). Monte Cristo sandwiches should be viewed as a high-risk food for SE. The egg on the bread’s inner surfaces may be inadequately cooked with the short cooking time of several minutes. If eggs are pooled and stored, as in commercial kitchens, care should be taken to reduce transmission of *Salmonella enteritidis*.

**REFERENCES**