An Outbreak of *Bacillus cereus* Food Poisoning — Are Caterers Supervised Sufficiently?

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Synopsis

Bacillus cereus *is an uncommonly reported cause of foodborne illness in the United States. In May 1989, an outbreak of* B. cereus *gastroenteritis occurred among 140 guests who had attended a catered wedding reception in Napa, CA. Investigation established Cornish game hens served at the event as the vehicle for disease transmission (OR = 29, P = 0.0001).*

Although the spores of B. cereus *are ubiquitous, large numbers of toxin-producing organisms (more than 10^5 per gram of food) are required for illness to occur. In the Napa outbreak, bacterial multiplication was facilitated at several points during the preparation and transportation of the food. While a licensed restaurant kitchen was used, the facilities were clearly inadequate for the event.*

At present, the California Health and Safety Code does not address the scope of catering operations. As caterers increase in number, there will be a growing need for governmental oversight to ensure that food production on a large scale is conducted safely.

On Sunday May 28, 1989, approximately 125 adults and 15 children attended a wedding reception in Napa County, CA. From 2:30 p.m. to 4:30 p.m., a privately catered outdoor buffet was provided that consisted of Cornish game hens, Kentucky Fried Chicken^R, salads, cheese, fruit, breads, and wedding cake. Champagne, beer, wine, mixed drinks, and various soft drinks were also available.

Throughout the next day, the groom's mother recorded telephone calls from a number of guests complaining of gastrointestinal symptoms that they felt were related to food consumed at the event. The Napa County Health Department was provided with a list of 38 ill people.

Investigations

Epidemiologic. Staff members of the Napa County Department of Environmental Health conducted telephone interviews with two groups of guests. Initially "self-selected" people who had reported illness to the groom's mother were questioned. During the course of these interviews, information from other ill and well members in the household was also obtained. Further investigation was compromised by the fact that it was not possible to identify readily everyone who attended the reception, because only a list of those who were invited was available. Additional interviews were conducted with as many of these persons as could be contacted. Inquiries were made concerning their health status and food selections at the wedding reception.

Microbiological. Fecal samples submitted to private laboratories by two of the guests during their illness were reportedly negative for common bacterial enteric pathogens. Neither of the specimens was available for further microbiological testing. Two cooked Cornish game hen halves and a portion of the wedding cake remaining from the reception were submitted through the Napa County Health Department to the Microbial Diseases Laboratory of the California Department of Health Services in Berkeley for analysis.

Environmental. The caterer owned a small restaurant in the city of Napa with a seating capacity of 29. On May 30, an environmental health inspection of the restaurant kitchen was performed. Prepara-

Table 1. Frequency of symptoms among 55 persons with *Bacillus cereus* food poisoning, Napa, CA, 1989

Symptom	Number with symptom	Percent
Diarrhea[1]	45	82
Cramps	44	80
Nausea	18	33
Vomiting	7	13
Fever (subjective)	6	11

[1] 3 or more loose stools in a 24-hour period.

tion and handling procedures of all foods served at the reception were reviewed. The layout and handling of food at the reception site were also assessed.

Results

Epidemiologic. A total of 79 (56 percent) of the estimated 140 persons attending the reception could be reached and were interviewed by telephone. The case definition for illness was any combination of abdominal cramps, nausea, vomiting, or diarrhea occurring within 24 hours following the buffet. Of those interviewed, 55 (70 percent) fulfilled these criteria. Although only 56 percent of the guests were interviewed, the overall attack rate was at least 39 percent, that is to say 55 out of 140. The median incubation period was 12 hours. The median duration of illness was 19 hours; three-quarters of those stricken had recovered within 24 hours, and all had recovered completely by 3 days.

Table 1 shows the distribution of symptoms among those who became ill. The major symptoms experienced were diarrhea (82 percent) and cramps (80 percent). A third of the victims had nausea, but only 13 percent experienced vomiting. Fever was not prominent.

The comparison of the food selections of those who were taken ill with those who were not (table 2) shows that consumption of Cornish game hen was highly associated statistically with illness (OR = 29.33, $P = 0.0001$). A much weaker, but still statistically significant association, was also shown for breadsticks. There was no correlation between hen and breadstick consumption to suggest that they were equivalent measurements.

Microbiological. Laboratory evaluation of the Cornish game hens resulted in an aerobic plate count of 70 million colony forming units per gram (CFU per gm). Of these, *Bacillus cereus* composed 14 million CFU per gm. One other foodborne pathogen, the anaerobe *Clostridium perfringens*, was present in counts of 99,000 CFU per gm. The aerobic plate count of the wedding cake was 120,000 CFU per gm, composed mainly of yeast and a *Micrococcus species*. No other foods were available for study.

Environmental. No history of recent illness was reported by any of the kitchen employees. Inspection of the restaurant revealed the kitchen to be small and cluttered. A refrigerator suitable for home use but not approved for commercial food storage was present. It was reportedly used only for beverages. The main refrigeration unit used for catering operated only marginally, at 48–50 degrees Fahrenheit, due to a refrigerant leak.

A series of unsafe foodhandling practices involving the Cornish game hens was identified.

1. The birds probably were thawed incompletely, with the result that the usual cooking time and temperature were inadequate;
2. Cross-contamination undoubtedly occurred when the same brush was used for basting both before and after cooking without being washed; and
3. On the day of the event, when the outdoor temperature reached 90 degrees Fahrenheit, the hens were held for approximately 4 1/2 hours in an unrefrigerated van while a delivery was made elsewhere in the county.

There were several anecdotal reports from guests that described the hens as undercooked and having an "off-taste." Handling of food items by servers at the reception appears to have been adequate.

Discussion

Although well-recognized as a food pathogen in Europe, *B. cereus* is reported relatively rarely as a cause of foodborne illness in the United States. From 1983 to 1987, only 16 (3 percent) of the 600 foodborne outbreaks of bacterial etiology reported to the Centers for Disease Control (CDC) were attributed to *B. cereus* (*1*).

Two clinical syndromes, each associated with an enterotoxin elaborated by *B. cereus*, are known. The first occurs within 6 hours after ingestion of a heat-stable toxin and is characterized primarily by upper gastrointestinal symptoms reminiscent of staphylococcal food poisoning. In the past, outbreaks of this type have almost invariably involved fried rice from Chinese restaurants because of the common practice of quickly stir-frying additional

Table 2. Comparison of food selections between those taken ill with *Bacillus cereus* food poisoning and those unaffected, Napa, CA, 1989

	Ill			Unaffected				
Food eaten	Yes	No	Percent	Yes	No	Percent	OR	P value[1]
Game hen	55	0	100.0	14	8	63.6	[2]29.33	[3]0.0001
Chicken[4]	1	51	1.9	3	19	13.6	0.12	0.0759
Potato salad	42	11	79.2	17	5	77.3	1.12	1.0000
Pasta salad	41	11	78.8	15	7	68.2	1.74	0.4959
Vegetable salad	31	21	59.6	8	14	36.4	2.58	0.1149
Cheese	43	9	82.7	17	5	77.3	1.41	0.7462
Bread	23	27	46.0	11	11	50.0	0.85	0.9546
Butter	22	28	44.0	6	15	28.6	1.96	0.3431
Bread stick	40	11	78.4	11	11	50.0	3.64	[3]0.0315
Apple	0	52	0.0	2	20	9.1	....	0.0855
Banana	8	44	15.4	4	18	18.2	0.82	0.7418
Strawberry	30	22	57.7	8	14	36.4	2.39	0.1546
Grape	15	37	28.8	5	17	22.7	1.38	0.7984
Punch	4	48	7.7	2	20	9.1	0.83	1.0000
Champagne	41	11	78.8	15	7	68.2	1.74	0.4959
Mixed drink	4	48	7.7	6	16	27.3	0.22	0.0560
Other drink	31	21	59.6	13	9	59.0	1.02	0.8282

[1] Chi-square with Yates' correction or Fisher's exact test.
[2] With small-sample adjustment.
[3] *P* value <0.05.
[4] Kentucky Fried Chicken[R].

ingredients into left-over, unrefrigerated rice (*2,3*). More recently, other vehicles have been identified (*4*).

The second syndrome resembles *C. perfringens* poisoning in that a heat-labile toxin produces predominantly lower gastrointestinal (diarrheal) disease about 12 hours after ingestion. Although enterotoxin testing was not performed in the Napa outbreak, it is interesting that two neighbors of the caterer who consumed leftover hens that were reheated in a microwave oven the next day did not become ill.

The spores of *B. cereus* are ubiquitous, and a wide variety of foods are contaminated to a small extent (*5*). Heavy *B. cereus* contamination (more than 10^5 organisms per gram of food) is needed to produce clinical illness. In this outbreak, bacterial multiplication was facilitated at several points during the preparation and transportation of the food, as reflected by the very high plate count of 14 million CFU per gm. *C.perfringens* was also detected in the hens at concentrations just below the CDC outbreak criterion of 10^5 per gm (*6*). While some of the illness could be due to *C. perfringens*, the concentration of this organism was far below that usually found in well-documented foodborne outbreaks.

In addition to the Cornish game hens, a statistically significant association was also found between illness and consumption of breadsticks. It was not possible to test this association while controlling for the effect of hen consumption since none of the eight who did not eat Cornish game hen became ill. It is unlikely that this food was an independent vehicle for disease, nor is there evidence that cross-contamination from the hens occurred. This is presumably a chance association that may occur when large numbers of variables are analyzed. Interestingly, a protective effect was associated with consumption of Kentucky Fried Chicken[R]. This item was offered to children as a substitute for the Cornish game hens. The only child who became ill had also tasted his parent's Cornish game hen.

Two types of epidemiologic approaches are generally used in the investigation of foodborne disease outbreaks (*7*). When all, or a representative sample of participants at a suspect meal are available, food-specific attack rates can be calculated to determine the risk of disease associated with each food item. In this outbreak, many members of the study group were self-selected. The remainder were identified through nonrandom calling. In this situation, a case-control approach is used. The proportion of specific food items selected by cases and controls is compared, yielding odds ratios rather than food-specific attack rates.

The Napa outbreak emphasizes the danger that exists when inadequate facilities are used for large-scale food preparation. Although the allowable seating capacity of a restaurant is controlled by kitchen size (*8*), the California Uniform Retail Food Facilities Law (from the California Health and Safety Code) does not directly address the

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scope of caterers. All food operations are defined as food facilities with subcategories of food establishment, vehicle, vending machine, produce stand, temporary food facility, satellite food distribution facility, stationary mobile food preparation unit, and mobile food preparation unit (Section 27521). Caterers are not specifically defined. Moreover, because many caterers work illegally out of private homes, they often escape oversight by regulatory agencies.

After the outbreak investigation was completed, the Napa County Health Department made recommendations to the caterer to reduce the potential for another outbreak. Training in food handling and in temperature control was provided, and enhanced refrigeration capacity (for both the restaurant and for food transport) was ordered. In addition, the caterer has been encouraged to do more cooking on-site rather than transporting foods.

Other outbreaks caused by *B. cereus* have occurred in settings where large quantities of warm food were transported (*9,10*). In the Napa outbreak, the caterer endeavored to serve nearly 300 people at two widely separated locations on the same day and clearly overtaxed the resources of his small kitchen that was licensed to serve only 29 restaurant customers. As the number of catering firms and the associated risk of foodborne illness continue to increase, stricter governmental oversight may be needed to ensure that the scope of catering or take-out operations is commensurate with the available facilities.

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