

An Outbreak of *Bacillus cereus* Implicating a Part-time Banquet Caterer

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ABSTRACT

Context and Objectives: In the aftermath of a party, 70% (25 of 36) of attendees had gastroenteritis. The objectives of this study were to identify a risk factor associated with the food during the banquet and to identify measures of control for avoiding this kind of outbreak in the future.

Method: A retrospective cohort study was used. We tried to reach by telephone all guests who had attended this banquet. A standardized questionnaire was used to provide information about identification of a risk factor, especially in relation to food.

Results: The cohort study has shown that potato salad served at the party was significantly associated with the disease. The mayonnaise used to prepare the salad was analyzed and *Bacillus cereus* was isolated (10^3 bacteria per gram).

Discussion: *Bacillus* microorganisms are usually found in decaying organic matter, dust, soil, vegetables and water. The bacteria has a remarkable ability to survive strong environmental stresses. There are strains of *B. cereus* that can cause food poisoning episodes with infective doses as low as 10^3 to 10^4 bacteria per gram. *B. cereus* is an infrequently reported cause of foodborne illnesses in Quebec and in North America but this may be due to underreporting of episodes. In this outbreak, bacterial multiplication was facilitated at several points in the interval between the preparation of the meal and the consumption of the banquet by the guests. Because the spores are ubiquitous and resistant to inactivation with most food grade disinfectants, temperature control should be the main focus of *B. cereus* outbreak prevention.

Conclusion: The meal was prepared by a restaurateur who was inexperienced in catering services and temperature control in particular when food is served outside the restaurant. This outbreak underscores the importance of maintaining meticulous hygienic procedures in food processing. Restaurateurs who offer catering services should be familiar with the constraints that are specific to this sector of the food industry.

La traduction du résumé se trouve à la fin de l'article.

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Spore-forming bacteria are serious problems in food processing because they are ubiquitous and very difficult to control. *Bacillus cereus* is a spore-forming bacteria whose spores are hydrophobic and resistant to pasteurisation. Some strains of *B. cereus* grow at temperatures as low as 4-6°C.¹ We report an outbreak of gastrointestinal illness due to *B. cereus* in which a part-time banquet caterer is implicated. The outbreak is likely attributable to unsafe food preparation.

BACKGROUND

On August 29, 1999, the Centre de santé publique de Québec (CSPQ) (Quebec, Canada) was notified of an outbreak of diarrhoea among guests who consumed food at a banquet function on the previous day, in Portneuf region, near Quebec City in the province of Quebec.

MATERIAL AND METHOD

Case definition

A case was defined as a person who had experienced diarrhoea (three or more loose stools in a 24-hour period) within two days after eating the meal on August 28.

Epidemiological investigation

The day after the notification of the outbreak, all guests who had attended this meal were interviewed over the telephone by nurses and physicians of the CSPQ, using a standardized questionnaire to establish time of onset and duration of illness as well as to determine the food and drink that had been consumed. Differences in food-specific attack rates were calculated and tested with two-tailed p-values using either Yates' correction of the Chi square or Fisher's exact test.

Environmental investigation

A sanitary inspection of the kitchen and a review of food preparation procedures and storage were done on August 30 by the environmental health officer from the Ministry of Agriculture of Quebec. The kitchen staff were interviewed about their current health status and their usual operational routines. The environmental health officer asked the restaurateur to provide samples of those foods prepared for the meal that were under suspicion.

Laboratory investigation

Stool specimens were requested from symptomatic guests and cultured for

enteric pathogens such as *Campylobacter*, *Yersinia*, *Bacillus cereus*, *Salmonella*, *Escherichia coli*, and *Clostridium perfringens*, and food items were tested for the same microorganisms.

RESULTS

Epidemiological investigation

The menu included vegetables with sauce, chicken with sauce, chicken sandwich, rice with vegetables, potato salad, pasta salad, cold cuts of ham and veal, cheese, grapes and cake. Of the 37 guests who had attended the lunch, 36 were interviewed and 25 (69.4%) reported being ill. The symptoms included diarrhoea (100%), abdominal cramps (100%) and nausea without vomiting (20%). The mean incubation period and median were estimated at 13 hours with symptoms lasting from 12 to 24 hours. An epidemic curve is presented in Figure 1. No outbreak cases consulted a physician. Food-specific attack rates (Table I) show that potato salad was the most likely source of infection ($p < 0.001$). No one on the staff was ill before or during the preparation of the meal.

Environmental investigation

The restaurant in question does not usually provide catering services. The meal had been prepared in a restaurant by two cooks and the owner of the restaurant the day before the celebration and was then refrigerated. The following day, the food was transported to the site of the festivities in an unrefrigerated vehicle and was eaten in a hall, kilometres away from the kitchen where it had been cooked. The meal was served from noon to 15h00 pm without any further refrigeration.

Some problems were identified by environmental health officers in relation to the preparation of the potato salad. The potatoes were cooked. The mayonnaise, which was prepared with eggs, Dijon mustard, oil, lemon and spices, was added to the potatoes before they had been cooled. The potato salad was then refrigerated until transported. At the party site, the potato salad was not refrigerated before or during the banquet.

Laboratory investigation

No stool specimens were collected since no one was ill at the time of the survey. No food prepared for that particular meal was available for testing because all items had been eaten. Samples of the mayonnaise used

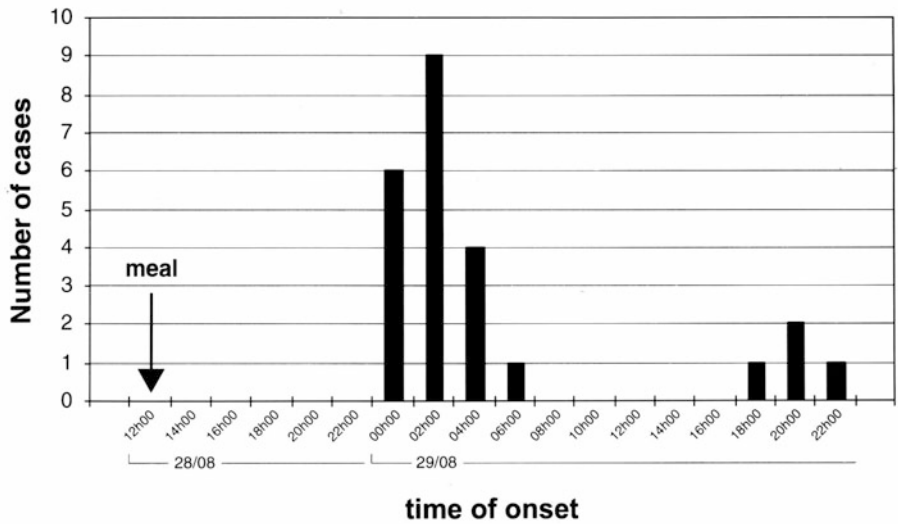


Figure 1. Epidemic curve of the outbreak of *B. cereus* implicating a part-time banquet caterer, Portneuf, Quebec, August 1999 (n=36)

for potato salad and of raw eggs were taken for analysis from the restaurant in question. *Bacillus cereus* grew from the cultures of the mayonnaise (10^3 per gram of food) and no bacteria was found in the eggs.

DISCUSSION

Bacillus microorganisms are usually found in decaying organic matter, dust, soil, vegetables and water and some species are part of the normal flora. The spore form of these bacteria have a remarkable ability to survive strong environmental stresses, making it difficult to prevent contamination of food with *B. cereus* spores. There are strains of *B. cereus* that can cause food poisoning episodes with infective doses as low as 10^3 to 10^4 bacteria per gram.¹⁻³

B. cereus may trigger a diarrhoeal form or an emetic form of food poisoning. The emetic form has a short incubation period lasting from 1 to 6 hours and symptoms are predominantly from the upper gastrointestinal tract and limited to vomiting. It mimics *staphylococcal* food poisoning. The diarrhoeal form has a longer incubation period that varies from 10 to 12 hours and symptoms are those of lower gastrointestinal involvement similar to that of *Clostridium perfringens* food poisoning. The diarrhoeal form is due to an enterotoxin that is produced during the vegetative growth of *B. cereus* in the small intestine, while the emetic toxin is produced by bacteria while growing in the food itself. The H-1 serotype has been strongly associated with the production of emetic toxin.^{2,4,5}

The clinical and epidemiological features of this episode and the identification of *Bacillus cereus* on cultures suggest that this outbreak was caused by this bacteria.

Some foodborne outbreaks caused by this bacteria have been reported with chinese rice, mashed potatoes, meat, vegetables, sprouts, milk and eggs.^{2,6} *B. cereus* remains an infrequently reported cause of foodborne illness in Quebec and in North America.⁷ It is possible that most outbreaks are not reported because the sickness is mild and the symptoms may be mistaken for those caused by *Clostridium perfringens* or *Staphylococcus aureus*.

In this outbreak, bacterial multiplication was facilitated at several points in the interval between the preparation of the meal and the consumption of the banquet by the guests. We know that *B. cereus* proliferates in poorly refrigerated, moist, cooked, proteinaceous foods. The temperature of cooking destroys vegetative bacteria that might otherwise compete. The spores of *B. cereus* may behave like the heat-resistant spores of *C. perfringens* that survive cooking, and undergo "heat shock" which stimulates germination.³ The most likely mechanism of contamination is cross-contamination; the spores of *B. cereus* are ubiquitous and very adhesive to different surfaces, hence the difficulty in controlling it.¹

In this outbreak, *B. cereus* was found in the mayonnaise (10^3 per gram of food). While we do not know exactly what happened during food processing, it is possible that vegetables were stored in the same container that was used to mix the mayon-

TABLE I

Food-specific Attack Rates and Relative Risks of Gastrointestinal Illness Associated with a Banquet in Portneuf, Quebec, Canada, August 1999 (n=36)

	Eat			Did Not Eat			RR*	p Values**
	Ill	Not Ill	Attack Rate %	Ill	Not Ill	Attack Rate %		
Vegetables	23	11	67.6%	0	0	0	—	—
Sauce	23	11	67.6%	0	0	0	—	—
Chicken with sauce	23	11	67.6%	0	0	0	—	—
Chicken sandwich	18	5	78.3%	5	5	50%	1.57	0.21
Rice	23	9	71.8%	0	1	0	—	0.30
Potato salad	21	2	91.3%	0	9	0	—	0.000002
Pasta salad	19	5	79.2%	4	5	44.4%	1.78	0.09
Cold ham	19	10	65.5%	4	1	80%	0.82	0.47
Cold veal	16	6	72.7%	6	5	54.5%	1.33	0.47
Cake	23	10	69.7%	0	1	0	—	0.32
Water	21	8	72.4%	2	3	66.6%	1.81	0.18

* Relative Risk

** Fisher's exact test

naise, or that the same utensils were used in the paring of vegetables and the mixing of the mayonnaise. Because the spores are hydrophobic, they are not washed away by rinsing. Since they adhere to all kinds of surfaces, they may well have contaminated the mayonnaise through this mechanism. The mayonnaise was prepared with fresh eggs and oil and the bacteria thrive in a proteinated environment.⁵ The mayonnaise was then added to hot potatoes which could have induced the sporulation of *B. cereus* in the salad. Heat can activate the spores, thus triggering germination and further multiplication of vegetative cells. Refrigeration does not inactivate the bacteria.^{1,8-10} After that, the meal was served at room temperature which could induce growth and multiplication of the bacteria.

Some strains of *B. cereus* are an emerging problem for the safety of food processing; their identification from food stored at refrigerator temperatures is more frequent.⁶ Because the spores are ubiquitous and resistant to inactivation with most food grade disinfectants, temperature control should be the main focus of a *B. cereus* outbreak prevention. Sufficient cooking, rapid cooling to avoid sporulation and reheating to a temperature of 60°C throughout the product will prevent *B. cereus* food poisoning.¹

This outbreak underscores the importance of maintaining meticulous hygienic procedures in food processing. One may wonder whether caterers are trained sufficiently.⁴ Restaurant owners are responsible for the safety of the food they prepare and for the training of their employees.⁴ Restaurateurs who offer catering services should be familiar with the constraints that are specific to this sector of the food industry. Professional training in safe food han-

dling practice should be made compulsory for all foodhandlers who work in restaurants or catering services.

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RÉSUMÉ

Contexte et Objectifs : Lors d'un banquet impliquant 36 convives, la majorité d'entre eux (70 %) ont développé une gastro-entérite. Les objectifs de cette étude sont d'identifier un facteur de risque liée à la nourriture lors de ce banquet et d'identifier des mesures de prévention et de contrôle efficaces pour éviter que ne se répète de tels épisodes.

Méthode : Nous avons effectué une étude de cohorte rétrospective. Nous avons tenté de rejoindre par téléphone tous les convives qui ont participé au banquet, en utilisant un questionnaire standardisé. Le questionnaire devait permettre d'évaluer l'exposition à un facteur de risque de nature alimentaire.

Résultats : L'analyse de cohorte a permis de mettre en évidence que les personnes qui ont consommé la salade de pomme de terre servie lors du banquet avaient plus de risque de développer une gastro-entérite que ceux qui n'en avaient pas consommé (p<0,001). Nous avons identifié la bactérie *B. cereus* dans la mayonnaise utilisée pour faire la salade de pomme de terre (10³ bactérie par gramme).

Discussion : La bactérie *B. cereus* peut se retrouver à différents endroits soit dans la poussière, le sol, les légumes ou l'eau. La bactérie peut survivre à différentes conditions dans l'environnement. Certaines souches de *B. cereus* peuvent être à l'origine d'intoxication alimentaire avec des doses infectantes aussi petites que 10³ ou 10⁴ bactéries par gramme. Les infections à *B. cereus* font probablement l'objet d'une sous-déclaration. Dans cette éclosion, la multiplication bactérienne a pu être facilitée à différents endroits entre le moment de la préparation du repas et sa consommation. Le repas a été préparé par un restaurateur qui avait peu d'expérience dans le service de traiteur.

Conclusion : Cette éclosion permet de mettre en évidence l'importance de bien appliquer les mesures d'hygiène et de contrôle de la température lors de la préparation des aliments. Ceci implique une bonne connaissance du phénomène de contamination alimentaire. Les restaurateurs qui offrent un service de traiteur devraient être familiers avec les contraintes liées aux bonnes pratiques de préparation et de conservation des aliments.