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The Thistle QA CEU No is: **MT-13/00142**.

Each attendee should claim **THREE** CEU points for completing this Quality Control Journal Club exercise, and retain a copy of the relevant Thistle QA Participation Certificate as proof of registration on a Thistle QA EQA.

MICROBIOLOGY LEGEND

CYCLE 33 ORGANISM 3

BACILLUS CEREUS

Bacillus cereus is an endemic, soil-dwelling, Gram-positive, rod-shaped, beta hemolytic bacterium. Some strains are harmful to humans and cause food borne illness, while other strains can be beneficial as probiotics for animals. It is the cause of "Fried Rice Syndrome," as the bacteria is classically contracted from fried rice dishes that have been sitting at room temperature for hours (such as at a buffet). *B. cereus* bacteria are facultative anaerobes, and like other members of the genus *Bacillus* can produce protective endospores. Its virulence factors include cereolysin and phospholipase C.

Symbiosis

B. cereus competes with other microorganisms such as *Salmonella* and *Campylobacter* in the gut, so its presence reduces the numbers of those microorganisms. In food animals such as chickens, rabbits and pigs, some harmless strains of *B. cereus* are used as a probiotic feed additive to reduce *Salmonella* in the intestines and cecum. This improves the animals' growth as well as food safety for humans who eat their meat.

Epidemiology

B. cereus food poisoning occurs year-round and is without any particular geographic distribution. The short-incubation form is most often associated with rice dishes that have been cooked and then held at warm temperatures for several hours. It is often associated with Mexican and Chinese restaurants, but in one reported outbreak, macaroni and cheese made from powdered milk turned out to be the source of the bacterium.

Long-incubation *B. cereus* food poisoning is frequently associated with meat or vegetable-containing foods after cooking. The bacterium has been isolated from 50% of dried beans and cereals and from 25% of dried foods such as spices, seasoning mixes and potatoes. One outbreak of the long-incubation form was traced to a "meals-on-wheels" program in which food was held above room temperature for a prolonged period before delivery to consumers.

Pathogenesis

B. cereus is responsible for a minority of food borne illnesses (2-5%), causing severe nausea, vomiting and diarrhea. *Bacillus* food borne illnesses occur due to survival of the bacterial endospores when food is improperly cooked. Cooking temperatures less than or equal to 100 °C allows some *B. cereus* spores to survive. This problem is compounded when food is then improperly refrigerated, allowing the endospores to germinate. Cooked foods not meant for either immediate consumption or rapid cooling and refrigeration should be kept at temperatures above 60 °C. Germination and growth generally occurs between 10-50 °C, though some strains are psychrotrophic. Bacterial growth results in production of enterotoxins, one of which is highly resistant to heat and to pH between 2 and 11; ingestion leads to two types of illness, diarrheal and emetic (vomiting) syndrome.

The diarrheal type is associated with a wide-range of foods, has an 8- to 16.5-hour incubation time and is associated with diarrhea and gastrointestinal pain. Also known as the long-incubation form of *B. cereus* food poisoning, it might be difficult to differentiate from poisoning caused by *Clostridium perfringens*.

The emetic form is commonly caused by rice that is not cooked for a time and temperature sufficient to kill any spores present, then improperly refrigerated. It can produce a toxin, cereulide, which is not inactivated by later reheating. This form leads to nausea and vomiting 1-5 hours after consumption. It can be difficult to distinguish from other short-term bacterial food borne pathogens such as *Staphylococcus aureus*. It was previously thought that the timing of the toxin production might be responsible for the two different courses of disease, but in fact the emetic syndrome is caused by a toxin called cereulide that is found only in emetic strains and is not part of the "standard toolbox" of *B. cereus*.

B. cereus is also known to cause chronic skin infections that are difficult to eradicate though less aggressive than necrotizing fasciitis. *B. cereus* can also cause keratitis.

Diagnosis

In case of Food borne illness, the diagnosis of *B. cereus* can be confirmed by the isolation of more than 10^5 *B. cereus* organisms per gram from epidemiologically implicated food, but such testing is often not done because the illness is relatively harmless and usually self-limiting.

The short-incubation or emetic form of the disease is diagnosed by the isolation of *B. cereus* from the incriminated food. The long-incubation or diarrheal form is diagnosed by isolation of the organism from stool and food. Isolation from stools alone is not sufficient because 14% of healthy adults have been reported to have transient gastrointestinal colonization with *B. cereus*. Because *B. cereus* gastroenteritis is generally a benign, self-limited illness, antimicrobial agents are of no value in management. Since the bacteria grow best at temperatures ranging from 4 to 60°C, infection may be prevented if cold food is refrigerated and if hot food is held at greater than 60°C before serving.



Bacillus cereus colonies on blood agar

Prognosis

Food borne illness from *B. cereus* is usually self-limiting. Most emetic patients recover within 6 to 24 hours, but in some cases the toxin can be fatal.

References

1. http://en.wikipedia.org/wiki/Bacillus_cereus
2. http://textbookofbacteriology.net/B.cereus_2.html

Questions

1. Discuss the morphological characteristics of *Bacillus cereus*.
 2. Discuss the pathogenesis of *Bacillus cereus*.
 3. Discuss the diagnosis *Bacillus cereus*?
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