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FACT SHEET

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Bacillus cereus: A Common Cause of Foodborne Illness

WHAT IS BACILLUS CEREUS?

B. cereus is a facultative anaerobic, spore-forming bacteria that can produce toxins. *B. cereus* is known for causing the foodborne illness more generally described as food poisoning. Food poisoning is caused by ingesting a large quantity of toxins that are produced by the vegetative *B. cereus* cells.

WHAT TYPES OF FOOD PRODUCTS ARE AT RISK?

B. cereus is found in rice, potatoes, poultry, dairy products, spices and dried foods and vegetables. As there are multiple strains of *B. cereus*, there are two distinct types of toxins that can be produced depending on the strain. These toxins are diarrhoeal and emetic. Due to these two different toxins, the illness can present in two forms.

Different types of food are susceptible to different forms of toxins, and therefore specific foods are associated with the different types of foodborne illness.

TYPE	FOODS	ONSET TIME (HOURS)	SYMPTOMS
Emetic	Starchy foods: rice, pasta, potatoes	0.5 to 6	Nausea, vomiting
Diarrhoeal	Vegetables, soups, sauces High protein foods: meat, dairy	6 to 15	Diarrhea, cramps

HOW TO PREVENT B. CEREUS TOXIN FORMATION WITH FOOD PROCESSING

B. cereus cells and spores are abundant in nature and may be present in food products if raw materials are contaminated and when the parameters of the food matrix and food processing enable their survival. The vegetative cells of *B. cereus*, their spores, as well as emetic and diarrhoeal toxins, have distinct conditions for optimal growth.

	VEGETATIVE CELLS		SPORES		EMETIC TOXIN		DIARRHOEAL TOXIN	
Characteristic	**Range**	**Optimal**	**Range**	**Optimal**	**Range**	**Optimal**	**Range**	**Optimal**
Temperature (°C)	4 – 55	30 – 37	10 – 40	20 – 25	12 – 37	12 – 15	10 – 43	32
pH	4.5 – 9.5	6 – 7	1 – 5.2	-	2 – 11	-	4 – 11	8.0
Water Activity	0.91 – 0.99	-	> 0.27	-	-	-	-	-
Salt (%)	< 7.5	-	-	-	-	-	-	-

Common methods of controlling *B. cereus* growth in food are:

- Thermal processing
- Acidification
- Salination
- Preservatives

Thermal processing involves heating the product to a specific temperature but also takes into consideration the amount of time the product is held at that specific temperature. Heating products to temperatures above 85 °C will ensure vegetative cells will not survive. Unfortunately, the spores and toxins are much more heat resistant and require higher temperatures for longer periods. Therefore, implementing additional processing techniques to control *B. cereus* in the food product is a must.

Acidification can be utilized to control the growth of *B. cereus* as the growth of the vegetative cells cannot occur in food products when the pH is below 4.5.

Drying to water activity below 0.91 can prevent the growth of bacterial cells, though spores can survive for long durations in dried foods with water activities of 0.27. Other methods to achieve a water activity below 0.91 include adding salt or sugar to the product as these ingredients can tie up water to ensure it cannot be used for the growth of *B. cereus*.

Preservatives can also be utilized to control the growth of *B. cereus* within food product. Typical preservatives used are sodium benzoate and potassium sorbate. The germination of *B. cereus* spore germination has been found to be inhibited by the natural preservative, nisin.

Ultimately, controlling the growth of the vegetative cells of *B. cereus* is important as these cells are what produce the toxins that cause food poisoning.

HOW TO PREVENT B. CEREUS TOXIN FORMATION DURING STORAGE?

Failing to adequately cool prepared foods within the recommended two hours, as specified by Health Canada, is the primary cause of foodborne illness by *B. cereus*. Following standard food handling practices, such as the quick cooling of foods after cooking and avoiding prolonged heat-keeping and room temperature storage, can aid in preventing the growth of B. cereus and the germination of spores in foods. Maintaining foods at temperatures below 4°C or above 60°C is critical for preventing the growth of *B. cereus*. This is often referred to as the "Danger Zone" as this temperature range is optimal for the growth of B. cereus cells and toxin formation.

Chilling to below 10°C will prevent the germination of spores and toxin formation, but chilling to below 4°C and freezing are effective for limiting the growth of *B. cereus* cells, spores and toxins.

Maintaining the cold chain from harvest through processing, transportation display, and home cooking are critical to prevent the growth of *B. cereus*.

REFERENCES AND FURTHER READING

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