Analysis of the emetic *Bacillus cereus* toxin cereulide

Eurofins offers reliable detection in food and baby food

Bacillus cereus and cereulide

Bacillus cereus is a widespread environmental bacterium whose spores can enter grains, milk, and plant-based raw materials through dust or soil particles. These spores are highly resistant and can survive drying, heating, and long storage periods even without active water. In production environments, *B. cereus* is also capable of forming persistent biofilms on equipment and surfaces, which can serve as hidden reservoirs for contamination.

Only a small proportion of *B. cereus* strains are emetic and able to produce cereulide, a highly temperature and pH stable cyclic peptide. Cereulide can form when spores from these emetic strains germinate and multiply in food. This typically occurs when meals or baby food are kept warm for extended periods, left at room temperature for hours, or when baby bottles are repeatedly reheated. Proper temperature control through rapid cooling or sufficient heating is essential to prevent spore germination and toxin formation.

Foods at Risk

Foods high in starch or protein are most prone to cereulide contamination, including rice, pasta, potatoes, dairy products, spice mixes, baby food, and ready-to-eat meals. Fruits, vegetables, and their processed products have also been linked to illnesses caused by *B. cereus* toxins.

In winter 2025/2026, several global recalls of infant formula were issued after elevated cereulide levels were detected in ARA oil (omega-6 fatty acid), an ingredient produced in a bioreactor that is used in infant nutrition.

Industry Challenges

Emetic *B. cereus* may be present when no cereulide is detectable. The toxin can form later during storage or product use. Conversely, cereulide remains in the food or on surfaces even when *B. cereus* is no longer detectable. Once present in food, cereulide cannot be removed or inactivated. Only the combination of chemical toxin analysis and microbiological testing provides reliable monitoring.

Effects on Humans

B. cereus toxins are linked to numerous food-borne outbreaks in the EU per year. After ingestion, symptoms such as nausea, violent vomiting, and stomach pain typically appear within 30 minutes to 6 hours.Infants are particularly vulnerable, as cereulide can disturb their salt balance and lead to dehydration, what can rapidly result in severe complications.

Importantly, emetic illness can occur even at relatively low bacterial counts.Even very small amounts of the toxin in the microgram-per-kilogram range can trigger acute emetic effects. Higher doses may cause liver or neurological damage, and in rare cases, severe outcomes including death have been reported.

Non-acute, low-level exposure may impair insulin secretion and damage pancreatic beta cells, which is why a potential link to diabetes development is being discussed. Chronic toxicity, however, remains poorly understood.

In February 2026, in its rapid risk assessment EFSA published an acute reference dose (ARfD) of 0.014 µg/kg body weight for infants. Based on estimated consumption values, it was determined that cereulide concentrations above 0.054 µg/l for infant formula and above 0.1 µg/l for follow-on formula may exceed safe levels.

Analysis at Eurofins

Cereulide is analysed according to standard method ISO 18465:2017 using an internal ^{13}C-labelled standard and LC-MS/MS. For infant formula, powdered matrices, and encapsulated ingredients, Eurofins applies a validated method modification with added water to ensure accurate detection. Interlaboratory studies have confirmed the method's validity.

The method is accredited and validated for a wide range of products, including infant formula, encapsulated oils, dairy products, grains, rice, pasta, potato products, ready-to-eat meals, and baby food. Additional matrices can be added upon request.

Eurofins' Competence Centre for Mycotoxins and Biotoxins has long-standing expertise in biotoxin testing within the Eurofins Food & Feed network. Eurofins handles high sample volumes, supported by automated sample preparation systems and multiple state-of-the-art instruments.

In addition, Eurofins offers rapid immunological methods as well as detection of the cereulide synthetase gene in *B. cereus*. These analyses provide fast and specific results for assessing the toxin-forming capacity and the presence of the corresponding toxin gene in presumptive *B. cereus.*

26GM5R02



Eurofins Food & Feed Testing Germany
service@ftdach.eurofins.com – www.eurofins.de