Food poisoning: New detection method for bacterial toxin

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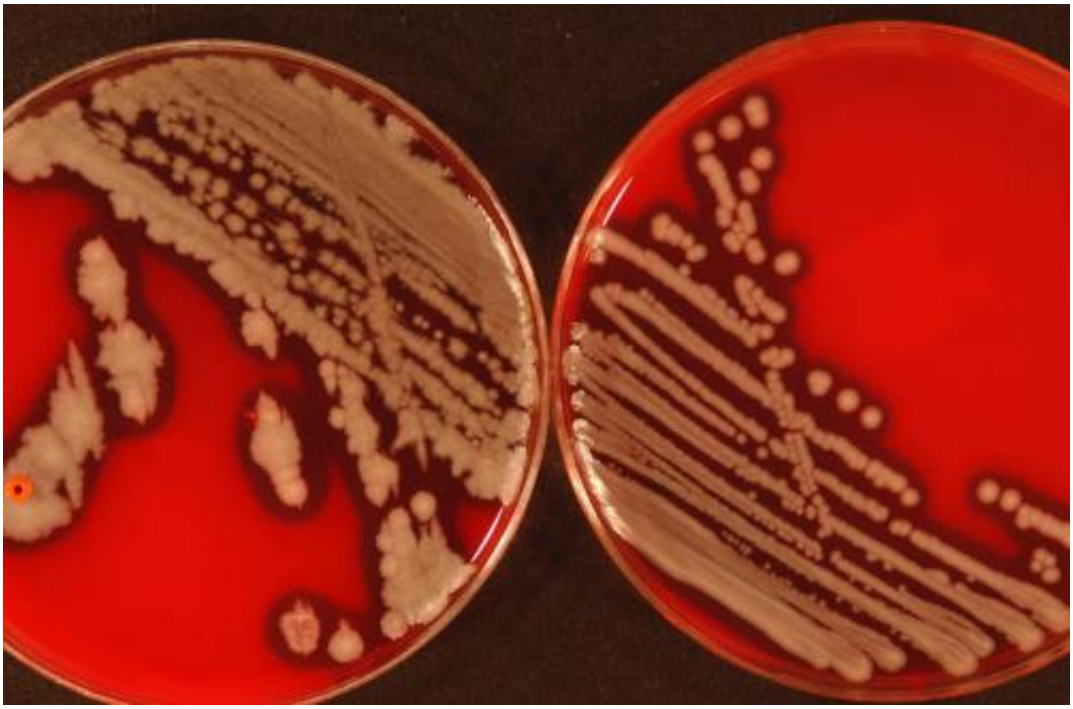

Typical growth pattern of *Bacillus cereus* colonies in petri dishes. Credit: Robert Koch-Institut

The *Bacillus cereus* bacteria is one of the potential causes of food poisoning. Indeed, a recent study in Analytical and Bioanalytical Chemistry shows that this versatile pathogen produces 19 different variants of a poison that causes nausea and vomiting in human beings. This variety could explain why some cases are relatively benign and others can result in death.

Across Europe, the number of food poisoning cases caused by the *Bacillus* species is on the rise. While unpleasant, infections resulting from *B. cereus* are usually not life-threatening. Depending on the toxin that is released by the bacteria, patients suffer either from diarrhea or from nausea and vomiting. The results can be more serious, however, with death occurring in some very rare cases.

The form of the illness that causes nausea and vomiting is known as emetic. The toxin responsible for this is cereulide. Researchers from Technische Universität München (TUM) and the University of Veterinary Medicine in Vienna have now developed a method for detecting this toxin. In the process, they identified 18 further variants to add to the cereulide already known to scientists.

Ready meals increase the risk of food-borne infections

Recently, around 100 children and staff contracted a *B. cereus* infection at a number of daycare centers near Paderborn in Germany. It turned out that they had all eaten rice pudding supplied by the same caterer. It is known that consuming pre-prepared meals increases the risk of food poisoning. The types of foods most likely to harbor *B. cereus* are starchy staples like rice, pasta and potatoes.

"A poor temperature management often plays a role," explains Prof. Thomas Hofmann from the Chair of Food Chemistry and Molecular Sensory Science. "The bacteria multiply, for example, in food that has been pre-cooked and then not heated up enough, or else not adequately cooled down beforehand."

In addition, *B. cereus* can produce spores that can survive high heat - and which are still capable of producing viable bacteria at lower

temperatures. These then often form bacterial toxins, which are in turn heat-stable - like cereulides.

Toxin attacks cell membrane

The toxin attacks the membrane of living cells. As for their structure, cereulides are like pincers grasping a potassium ion. The potassium ions alter the electric potential at the cell membrane, resulting in damage to the membrane and cell death.

"The toxicity of the individual types of cereulides depends on their chemical structure. The more lipophilic they are, the easier it is for them to attach to the membrane composed of fatty acids," says Prof. Siegfried Scherer, head of the Chair for Microbial Ecology.

New detection method is being evaluated

"Prior to this project, there was no satisfactory method of detecting the cereulide toxin in food," relates Hofmann. "With our mass spectrometry-based process, we have created an important starting point for the reliable detection of the toxic bacteria."

This will make it easier to assess the risk inherent in contaminated products - and the role played by the individual cereulide variants. The new detection method is currently being jointly evaluated at European level together with the US Food & Drug Administration (FDA), and preparations are being made for its deployment.

More information: Chemodiversity of cereulide, the emetic toxin of Bacillus cereus; Sandra Marxen, Timo D. Stark, Elrike Frenzel, Andrea Rütschle, Genia Lücking, Gabriel Pürstinger, Elena E. Pohl, Siegried Scherer, Monika Ehling-Schulz, Thomas Hofmann; *Analytical and*

Bioanalytical Chemistry; DOI: 10.1007/s00216-015-8511-y