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Presumptive *Bacillus cereus*/*Bacillus thuringiensis* in vegetable food: Natural contaminant or pesticide residue?

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The *Bacillus (B.) cereus* group (also called *B. cereus* sensu lato or presumptive *B. cereus*) currently comprises eight closely related species which are difficult to differentiate and are thus not distinguished in routine diagnostics. However, the potential to cause foodborne disease differs between these species. Especially, *B. cereus* and *B. cytotoxicus* are considered foodborne pathogens whereas discussions on the pathogenic potential of *B. thuringiensis* are ongoing. Presumptive *B. cereus* is common contaminants of vegetable food, while the individual *B. cereus* group species with its toxinogenic potential remains mostly unknown. A possible unnatural source of contamination is the application of *B. thuringiensis* based biopesticides. Still, evidence for biopesticide residues on food is scarce. This lack of evidence was also noted by the EFSA Panel on Biological Hazards in a Scientific Opinion of 2016. In order to address these issues, we analyzed samples of spices, dried and fresh herbs, and bell pepper for presumptive *B. cereus*. Additionally, tomato and sprout samples were analyzed by food inspection laboratories of the federal states in Germany. Obtained isolates were further characterized in terms of species affiliation, toxinogenic potential and partially their multilocus sequence type (MLST). The presumptive *B. cereus* prevalence and contamination levels ranged from 8 to 95% and from 101 to 104 cfu/g. Most strains were able to produce toxins. The presumptive *B. cereus* populations from bell pepper and tomatoes were dominated by *B. thuringiensis* (93% and 99%, respectively). These strains were indistinguishable from the biopesticide *B. thuringiensis* subsp. aizawai ABTS 1857 or *B. thuringiensis* subsp. kurstaki ABTS-351, respectively, based on the following parameters: toxin genes, toxin production, cry1 gene and parasporal crystal content as well as MLST profiles. These findings indicate that the *B. thuringiensis* burden in the analyzed bell pepper and tomato samples may originate from residues of biopesticides.

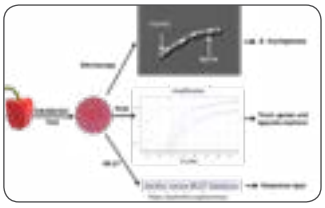

Figure 1: Analysis of presumptive *B. cereus*/*B. thuringiensis* from vegetable food

Recent Publications

1. Frederiksen K, Rosenquist H, Jorgensen K and Wilcks A (2006) Occurrence of natural *Bacillus thuringiensis* contaminants and residues of *Bacillus thuringiensis*-based insecticides on fresh fruits and vegetables. Applied and Environmental Microbiology 72(5):3435-3440.
2. Frentzel H, Kraushaar B, Krause G, Bodi D, Wichmann-Schauer H, Appel B and Mader A (2018) Phylogenetic and toxinogenic characteristics of *Bacillus cereus* group members isolated from spices and herbs. Food Control 83:90-98.
3. Hendriksen N B and Hansen B M (2006) Detection of *Bacillus thuringiensis* kurstaki HD1 on cabbage for human consumption. FEMS Microbiology Letters 257(1):106-111.
4. Raymond B and Federici B A (2017) In defense of *Bacillus thuringiensis*, the safest and most successful microbial insecticide available to humanity-a response to EFSA. FEMS Microbiology Ecology DOI :10.1093/femsec/fix084.

Biography

Hendrik Frentzel is a Scientific Assistant in the Laboratory for Spore Formers in the unit Microbial Toxins, Department Biological Safety of the German Federal Institute for Risk Assessment (BfR). His research focusses on the risks related to the occurrence of *Bacillus* cereus group species in food. In this context, research activities are directed towards species identification, toxin-gene/toxin detection and phylogenetic analysis.

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