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Adoption of WGS Tools for Toxin Profiling in Food Products

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Overview

- Ingestion vs Infection
- *Bacillus cereus* toxins
- Limitations of functional assays
- Toxin profiling with WGS

Intoxication vs Infection

- Preformed toxin
- Temperature abuse
- Nausea & vomiting
- Short time to symptoms
- Associated with
  - *S. aureus*
  - *B. cereus*

- Bacteria ingested
- Bacterial growth
- Symptoms abdominal cramping, diarrhea, fever, and chills.
- Long time to symptoms
- Most commonly associated with:
  - *Salmonella*
  - *Campylobacter*
  - *Listeria*
  - *B. cereus*

Food is recalled if:

>10,000 CFU/g *Bacillus cereus* or *Staphylococcus aureus*

OR toxin detected using functional assay

Genome assemblies - Byper

- Developed by Mark Wiedmann's lab
- Various typing schemes employed
  - Taxonomic markers
  - Virulence genes

Functional assays: Pros and cons

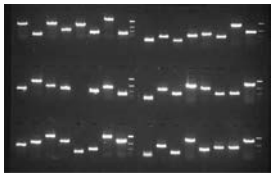
Cereulide

- UHPLC/ESI-MS/MS in positive mode
- Expensive equipment
- Labor intensive method requires experienced staff

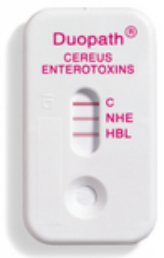
Diarrheal toxins Hbl and Nhe, but not CytK

- Antibodies target one protein of tripartite protein
- Detection requires bacterial growth

WGS from food extracts



PCR



LFD for Hbl and Nhe

WGS Toxin Profiles

Genus/species	*hbl*						
	Strain	Infant Formula	Pancake Mix	Whey Powder	Gravy	Potato Mix	Cooked Rice
Bacillus cerues x4							
Staph aureus							
B. licheniformis							
Mixed							
Genus/species	*nhe*						
	Strain	Infant Formula	Pancake Mix	Whey Powder	Gravy	Potato Mix	Cooked Rice
Bacillus cerues x4							
Staph aureus							
B. licheniformis							
Mixed							

positive

negative

Future endeavors

RNA sequencing studies

Apply similar pipelines and workflow to *Staphylococcus aureus* and enterotoxins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References

Carroll, L.M. et al. Rapid, High-Throughput Identification of Anthrax-Causing and Emetic *Bacillus cereus* Group Genome Assemblies via Btyper, a Computational Tool for Virulence-Based Classification of *Bacillus cereus* Group Isolates by Using Nucleotide Sequencing Data. AEM (2017)

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