news digest #023

Ice Cream's Hidden Dangers: *Listeria* and *Salmonella* in your freezer

Author: Olaf Degen, Director Industry Microbiology, Bruker Microbiology & Infection Diagnostics

Ice cream is a beloved dessert enjoyed worldwide for its creamy texture and sweet flavors, captivating people of all ages. From classic chocolate cones to exotic salted caramel, ice cream delights our taste buds. However, beyond its deliciousness, maintaining strict hygiene and food safety during production is crucial. Ensuring cleanliness from farm to scoop is essential for safe consumption. Keeping ice cream free of *Salmonella* and *Listeria* is vital for public health. Modern laboratory technologies like MALDI-TOF MS and IR Spectroscopy play a key role in guaranteeing the highest product quality and consumer safety.

The culprits

Two main bacteria, *Salmonella* and *Listeria*, can pose significant risks in ice cream production if not handled properly. Ensuring safe production, from sourcing quality ingredients to maintaining clean equipment, is essential. In recent years, small-, medium-sized and multinational companies have been involved in *Salmonella* and *Listeria* outbreaks, making ice cream a hot topic for microbiologists. Stringent safety measures, proper environmental monitoring, and testing of ingredients as well as retail products are crucial steps in the prevention of outbreaks.

Keeping ice cream free of *Salmonella* and *Listeria* is vital for public health. *Salmonella* is well known for causing gastroenteritis from contaminated food. These bacteria can be found in raw eggs, milk, other dairy products, contaminated water, utensils and surfaces. Vigilant handling, storage, and production are essential to safeguard food quality. *Listeria monocytogenes*, less known to the public, is another bacterium found in contaminated ice cream. It can cause listeriosis, a serious illness with symptoms ranging from mild flu-like discomfort to severe complications like meningitis, particularly affecting pregnant individuals, newborns, and those with weakened immune systems.

While cold products like ice cream are often considered safe due to low temperatures normally inhibiting bacterial growth, this assumption can be risky. *Listeria* can survive freezing and can even multiply in refrigerated environments. Let's dive into notable outbreaks from the past and then have a look at new rapid detection methods like the MALDI Biotyper® and IR Biotyper®.

Ice cream-associated outbreaks

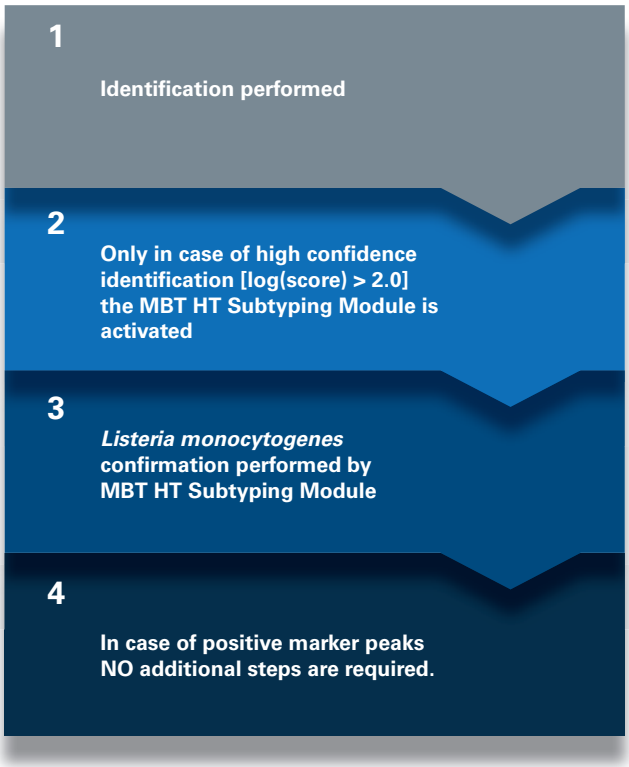
In August 2023, an outbreak of *Listeria* infections was traced back to Soft Serve On the Go cups and other dairy and non-dairy (parve) products (incl. ice creams, cakes, pies) produced by a company in Brooklyn, NY. The CDC reported two illnesses in two states, with the last illness onset in May 2023. This outbreak led to recalls and heightened vigilance. The FDA published a report on the outbreak investigation of *Listeria*.[1] Along with the CDC, the FDA assisted the Florida Department of Health and the Florida Department of Agriculture & Consumer Services in investigating another outbreak of *Listeria monocytogenes* infections linked to ice cream from a manufacturer in Sarasota, FL. The CDC reported 28 illnesses in 11 states, resulting in hospitalizations and raising awareness about ice cream safety.[2]

In 1994, the Minnesota Department of Health detected an increase in *Salmonella enteritidis* infections. This nationwide outbreak was most likely due to the contamination of pasteurized ice cream premix during transport in tanker trailers that had previously carried non-pasteurized liquid eggs containing *S. enteritidis*. It was estimated that *S. enteritidis* gastroenteritis developed in 224,000 people in the United States after eating the ice cream of the relevant brand, with an attack rate of 6.6 percent.[3]

Rapid detection technologies

The MALDI Biotyper and IR Biotyper are innovative instruments used in many laboratories to deliver confirmation results starting with colony material, and basic root cause analysis. MALDI-TOF MS is the gold standard for microbial identification in thousands of laboratories around the globe, as well as for the confirmation of *Salmonella* spp., *Listeria* spp., *Listeria monocytogenes*, and *Cronobacter* spp.

A bacterial colony is transferred onto a MALDI target plate, whereafter a droplet of a a matrix solution is applied in a one-step procedure. A laser beam ionizes the sample, and the resulting mass spectrum is compared to a reference database. This proteomics technology is very fast and cost-effective. The MALDI Biotyper comes with MicroVal certificates after full international validation for the confirmation of *Salmonella*, *Listeria*, and *Cronobacter* colonies according to ISO 16140-6 and is part of two AOAC OMA methods.[4,5] In case of *L. monocytogenes* the MALDI Biotyper uses a hierarchical approach for its confirmation. After the initial identification process described above, a more detailed analysis is automatically triggered and the MBT HT Subtyping Module, a crucial software add-on, is used for the accurate differentiation of closely related *Listeria* species. *L. monocytogenes* is the major pathogen, while human infections with *L. ivanovii* are extremely rare and *L. welshimeri* lacks pathogenicity factors.



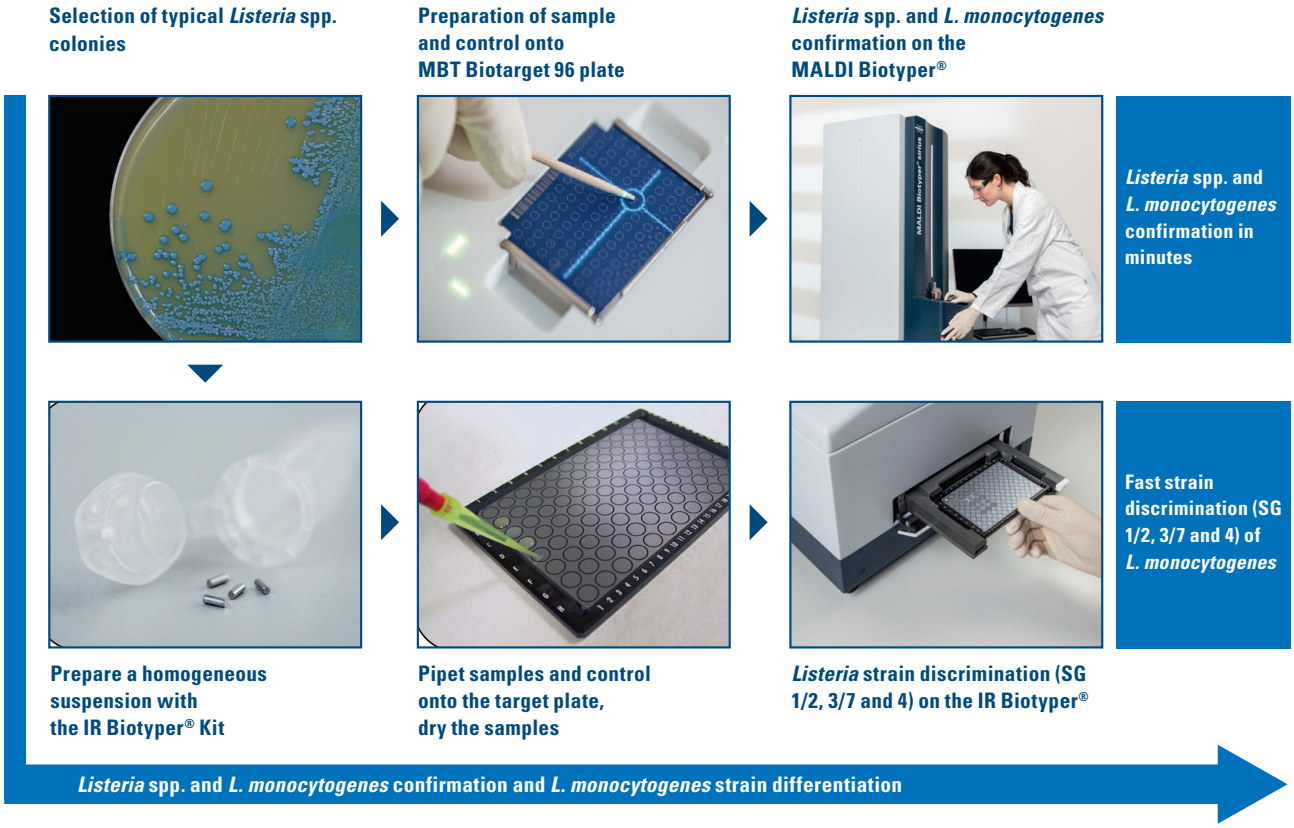
Seamless and fast workflow for *Listeria* subtyping.

The IR Biotyper workflow starts from colonies on an agar plate and is a good solution for root cause analysis and hygiene monitoring. Bacterial cells are prepared with the IR Biotyper kit, and a suspension is deposited onto a dedicated sample plate and dried. IR absorption reveals characteristic molecular vibrations based on carbohydrate, protein and lipid composition of the bacteria.

A dedicated data analysis software shows similarity scores indicating potential clusters and can deliver a same-day root cause analysis. For instance, the discrimination of *Salmonella* O-Serotypes is achievable using available training sets. Also, single lab validations for *Listeria* have been conducted by a German state laboratory. Additionally, Bruker offers a training set, the *Listeria monocytogenes* classifier, which can be used to distinguish outbreak strains within a single laboratory.

Benefits of MALDI-TOF MS and FT-IR

The MALDI Biotyper and IR Biotyper provide quick and cost-effective methods for microbial identification and strain discrimination. In contrast, Whole Genome Sequencing (WGS) delivers detailed genetic information but demands significant bioinformatics expertise and considerable computational resources. The MALDI Biotyper delivers species-level results in minutes, without the need for costly reagents or extensive training. Meanwhile, the IR Biotyper analyzes intact cells without requiring DNA extraction, enabling basic root cause analysis and contamination tracing within hours. Laboratories can choose the right tool based on their specific needs, balancing speed, accuracy, and resource availability. Local ice cream makers and multinational brands alike should implement proper environmental monitoring programs, testing protocols for ingredients and final products, and quickly adopt the MALDI Biotyper and IR Biotyper in a modern, state-of the-art workflow to ensure the highest food quality and consumer safety.



Typical workflow for confirmation of *Listeria* spp. and *L. monocytogenes*, followed by strain differentiation using classifiers provided by the IR Biotyper: Starting from colony material and using both instruments in parallel or sequential, *Listeria* spp. and *L. monocytogenes* confirmation and *L. monocytogenes* strain discrimination (SG 1/2, 3/7 and 4) can be achieved very fast, starting from colony material.

References

1 Outbreak Investigation of *Listeria*: Ice Cream (August 2023) https://www.fda.gov/food/outbreaks-foodborne-illness/outbreak-investigation-listeria-ice-cream-august-2023

2 The Big Olaf Creamery case from Sarasota, FL described at the following website: Outbreak Investigation of *Listeria monocytogenes*: Ice Cream (July 2022). www.fda.gov/food/outbreaks-foodborne-illness/outbreak-investigation-listeria-monocytogenes-ice-cream-july-2022

3 Thomas W. Hennessy et al. A National Outbreak of *Salmonella enteritidis* Infections from Ice Cream. N Engl J Med 1996; https://doi.org/10.1056/nejm199605163342001

4 MicroVal certificates for confirmation methods: https://microval.org/en/issued-certificates/

5 Official Methods of Analysis of AOAC INTERNATIONAL (OMA) is a publication of AOAC INTERNATIONAL comprised of more 3,000 validated methods: www.aoac.org/official-methods-of-analysis

6 Helene Oberreuter et al. Validated differentiation of *Listeria monocytogenes* serogroups by FTIR spectroscopy using an Artificial Neural Network based classifier in an accredited official food control laboratory, Clinical Spectroscopy,Volume 5,2023, https://doi.org/10.1016/j.clispe.2023.100030

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Online information
bruker.com/microbiology

Bruker Daltonics GmbH and Co. KG

Bremen · Germany
Phone +49 (0)421-2205-0

info.md@bruker.com

Bruker Scientific LLC

Billerica, MA · USA
Phone +1 (978) 663-3660