

Outbreak of *Listeria Monocytogenes* Infections Linked to Whole Apples Used in Commercially Produced, Prepackaged Caramel Apples - United States, 2014-2015

Author: Kristina Angelo
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Summary: New Advanced Molecular Detection technology helped CDC disease detectives solve the first-ever *Listeria* outbreak in caramel apples, a popular holiday treat.

Abstract:

Background: *Listeria monocytogenes* (Lm) infection is the third leading cause of death from foodborne illness in the United States. Lm isolates undergo pulsed-field gel electrophoresis (PFGE) and whole genome sequencing (WGS) to identify disease clusters. In November 2014, two multistate clusters of Lm infections with distinct PFGE patterns were detected. Due to geographic and temporal overlap and a case with co-infection, they were investigated together to identify the source and prevent illnesses.

Methods: Cases were defined as illnesses with highly related Lm strains by WGS reported to PulseNet, the national molecular subtyping network for foodborne disease surveillance, with onset from 10/17/2014 to 2/12/2015. Information was collected on foods consumed in the weeks before illness onset using hypothesis-generating questionnaires and open-ended interviews. Case-patient food exposures were compared with data from listeriosis patients with genetically unrelated Lm using Fisher's exact test. Traceback was performed to identify the suspect food source. WGS was performed on all case-patient, produce, and environmental isolates.

Results: Thirty-five cases from 12 states and 1 from Canada were identified; 34 patients were hospitalized and seven died. Three cases of meningitis occurred among healthy children. Twenty-eight (90%) of 31 patients reported consuming prepackaged caramel apples (multiple brands) compared with 1 (2.8%) of 36 patients with unrelated Lm isolates ($p < 0.001$). Environmental and produce samples from a common apple supplier were highly related to clinical isolates by WGS. Three caramel apple producers and the apple supplier issued voluntary recalls.

Conclusions: Whole apples used in prepackaged caramel apples were the outbreak source. This is a new vehicle for Lm infections. Research is needed to understand factors specific to caramel apple production to prevent further contamination and illness.