

Investigation Report:
Factors Potentially Contributing to the
Contamination of Peaches Implicated in
the Summer 2020 Outbreak
of *Salmonella* Enteritidis

Executive Summary

Between August and October 2020, the U.S. Food and Drug Administration (FDA) and multiple state and federal partners investigated an outbreak of *Salmonella* Enteritidis infections linked to peaches packed or supplied by a large grower/producer. In total, in the U.S. there were 101 reported illnesses across 17 states. Based on the historical outbreak data, this multistate outbreak appears to represent a novel commodity/pathogen pair. The epidemiological and traceback investigation identified the large grower/producer's packinghouses, cooling facilities and/or orchards as a potential source of the peaches and helped prioritize investigational activities.

The investigation did not result in finding the outbreak strain (via whole genome sequencing (WGS)) in investigation samples, however, numerous *Salmonella* isolates were found in samples collected from the peach orchards. Multiple *Salmonella* isolates from product (peach) and peach tree leaf sampling activities conducted during this investigation genetically resembled historical chicken and cattle isolates not associated with this outbreak or any known foodborne illnesses. Geospatial analyses of the orchards that supplied fresh peaches during the period of interest, coupled with WGS analysis that showed closely related *Salmonella* isolates from peach/leaf and historical animal samples, suggested several plausible opportunities for contamination including from airborne transmission of fugitive dust possibly originating from adjacent animal operations (e.g., poultry or cattle). The large grower/producer cooperated with FDA throughout the investigation and is continuing to engage with FDA on the agency's findings and recommendations.

FDA views the implementation of appropriate science-and-risk-based produce safety interventions as the most effective and practicable means to enhance the safety of fresh produce. Food safety is a shared responsibility that involves food producers, distributors, manufacturers, retailers, and regulators. FDA also recognizes the interconnection between people, animals, plants, and their shared environment when it comes to public health outcomes. As such, we strongly encourage collaboration among various groups in the broader agricultural community (i.e., operators of animal production, produce growers, state and federal government agencies, and academia) to address this issue. With this collaboration, those managing animal operations, alongside other industry, academic, and government partners, can work to identify and implement measures to reduce the likelihood of fresh produce contamination with human pathogens as in this case with tree fruit.

Contents

Executive Summary	1
I. Outbreak Overview.....	3
II. Outbreak Response Activities and On-Farm Outbreak Investigation	3
III. Factors Potentially Contributing to Contamination	6
IV. Recommendations.....	7
V. Relevant Links	8

I. Outbreak Overview

Between August and October 2020, the FDA and multiple state and federal partners were involved in an investigation of an outbreak of *Salmonella* Enteritidis infections linked to peaches packed or supplied by a large grower/producer.

On August 19, 2020, FDA, in conjunction with the U.S. Centers for Disease Control and Prevention (CDC), state partners, and Canadian officials (Public Health Agency of Canada and Canadian Food Inspection Agency), announced an investigation into an outbreak of *Salmonella* Enteritidis infections in multiple U.S. states and Canadian provinces associated with the consumption of bagged peaches (later expanded to include all peaches). FDA's traceback investigation identified multiple distributors, packing facilities, and orchards that supplied peaches during the time period of interest.

On August 21, 2020, the large grower/producer recalled bagged peaches that they supplied to retailers nationwide and on August 22, 2020, this recall was expanded to bulk or loose peaches as well. As a result of the producer's recall, multiple firms initiated downstream recalls or posted notices on their respective websites including: ALDI, Festival Foods, Food Lion, Hannaford, Kroger, Jay-C, King Soopers, City Market, Fry's, Ralphps, Food 4 Less, Foods Co. Smiths, Stop & Shop, Target, Walmart, Wegmans, and Russ Davis Wholesale. By August 28, 2020, 16 companies had issued additional product recalls due to the possibility of contaminated peaches received from a supplier. In addition to the U.S. recalls, FDA also made public a list of foreign consignees in Australia, Canada, China, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, the Philippines, Singapore, Taiwan, and the United Arab Emirates to which recalled peaches were shipped. Countries that issued recalls of peaches included Canada, New Zealand, and Singapore.

In total, in the U.S. there were 101 reported illnesses across 17 states. The outbreak resulted in 28 hospitalizations. No associated deaths were reported. Illness onset dates ranged from June 29 to August 27, 2020. The outbreak was declared over in the U.S. by [CDC on October 16, 2020](#).

A review of publicly available data reported to the National Outbreak Reporting System ([NORS Dashboard](#)) identified three outbreaks (2012, 2013, and 2014) linked to peaches between 1971 and 2018; however, none were due to salmonellosis and two were single state outbreaks. Based on the NORS data, this multistate outbreak appears to represent a novel commodity/pathogen pair in the U.S.

II. Outbreak Response Activities and On-Farm Outbreak Investigation

The epidemiologic and traceback investigation conducted by FDA, CDC, and state partners determined that peaches packed or supplied by a large grower/producer were the likely source of this outbreak in the U.S. As of October 16, 2020, eighty-one percent of ill persons (50/62) interviewed reported eating fresh peaches in the week before their illnesses started. Compared to the 2006-2007 FoodNet population survey data, in which 20 percent of respondents reported eating peaches, the proportion of cases reporting eating any type of peaches in this outbreak was

significantly higher than expected ($p < 0.001$). Of the people who reported information on how the peaches were packaged, 63 percent reported buying loose peaches and the remaining reported buying pre-bagged peaches.

Food exposure information for ill consumers in the outbreak investigation was evaluated to determine points of service at which peaches may have been purchased. Based on this information, FDA, in collaboration with state and other government officials, initiated a traceback investigation of peaches associated with case exposures. Traceback of peaches from 14 points of service associated with 18 case-patients was conducted. The 18 illnesses across eight states (CT, IA, MD, MI, MN, NY, OH, WI) represented geographically distinct case-patients with the strongest evidence via purchase information, invoices, bills of lading, and electronic data, among *Salmonella* Enteritidis cases from this outbreak with exposure to peaches. The traceback investigation identified multiple distributors, packing facilities, and orchards that supplied bagged and/or loose peaches during the timeframe of interest to the identified points of service, with a large grower/producer's peaches and packing facilities supplying the majority of peaches associated with points of service during the timeframe of interest; however, a single point or source of contamination was unable to be determined by the traceback investigation.

A tandem traceback investigation performed by the Canadian Food Inspection Agency also identified peaches from the large grower/producer as the likely source of the cases in Canada.

The traceback evidence obtained during the outbreak investigation informed and helped prioritize two subsequent investigations of peach packing/holding operations and peach orchards in Cutler, Kerman, and Sanger, California. The on-site investigations were conducted in collaboration with California state partners between August and October 2020.

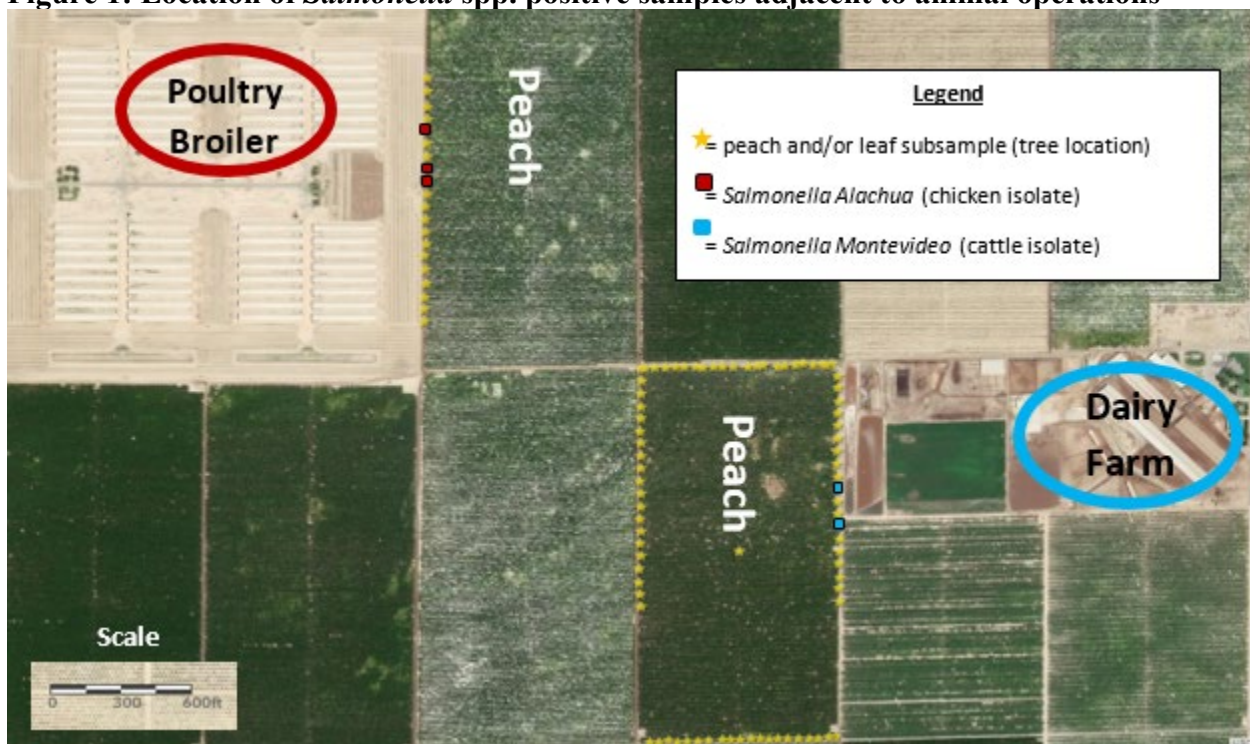
On-site investigations were conducted by the FDA's Produce Safety Network and Office of Regulatory Affairs, the California Department of Food and Agriculture, and the California Department of Public Health via the California Food Emergency Response Team. The multi-disciplinary teams had expertise in public health, produce safety, agriculture, veterinary medicine, epidemiology, microbiology, and environmental health. In addition to the extensive epidemiological and traceback analyses performed during the outbreak investigation, the investigation teams' actions and reports were informed by on-site observations, environmental sampling, and inquiries directed to responsible persons on-site at farm operations.

Potential sources and routes of *Salmonella* were assessed for numerous peach orchards and packing lines, all located in California, that may have grown and/or handled peaches possibly contaminated with the outbreak strain. Environmental samples (environmental swabs and drag-swabs) from the packing houses, product samples (peaches) from the packing houses and orchards, and peach tree leaves from the orchards were collected during the investigations, all of which tested negative for presence of the outbreak strain.

The investigation teams conducted detailed interviews with farm personnel during investigations at locations identified by the traceback investigation. The investigators observed receiving of fruit, cooling, packing, and storage of fruit, as well as the facility cleaning/sanitizing practices during

the initial site visit. The investigation teams also collected information regarding relevant food safety procedures, policies, and practices. However, because the investigations were all conducted after the company’s product recall, the conditions in the packing facilities may not have been consistent with conditions at the timeframe of interest due to subsequent cleaning/sanitization and review/update of food safety programs. In total, over 700 tests were conducted, including: approximately 180 tests of peach leaves and approximately 20 tests of peaches collected from multiple orchards, approximately 480 tests of environmental samples and approximately 20 tests of peach products collected from three peach packing/holding facilities, and approximately 20 tests of peach products collected from two additional distribution centers (one in Iowa and one in Illinois) for testing. While no test results matched the 2020 outbreak strain, four tests returned positives for *Salmonella* Alachua and two tests returned positives for *Salmonella* Montevideo.

Figure 1: Location of *Salmonella* spp. positive samples adjacent to animal operations



Note: This map does not include all positive *Salmonella* spp. locations. *Salmonella* enterica subsp. Enterica serovar Montevideo isolates (in blue) are median of 16 SNPs from beef and cattle isolates from 2018, 2019 and 2020. *Salmonella* enterica subsp. Enterica serovar Alachua isolates (in red) are identical (0-2 SNP) to a surveillance sample of chicken from 2019.

The scope and approach of these investigations focused on FDA-regulated entities to identify growers and operations in the peach supply chain that may have contributed to the outbreak. The investigation provided insights on several factors that potentially contributed to the contamination of peaches linked to this outbreak and other positive *Salmonella* spp. results found during this investigation. Specifically, isolates from one peach test and three leaf tests, each collected from an orchard adjacent to a poultry facility, were positive for *Salmonella* Alachua, which prompted a follow-up investigation, more closely focused on growing areas; these positive results also

prompted voluntary recall by the firm, preventing the tested, contaminated product from reaching the market.

The follow-up investigation expanded the sampling areas onto orchards identified by traceback information and focused on sample collection of products (peach), orchard tree-leaves and soil drag-swabs. There were no field operations (e.g., harvesting) being conducted in the orchards of interest and no peaches were available for collection at the time of the follow-up investigation. *Salmonella* Montevideo was detected in two tests of orchard canopy leaves collected during this follow-up investigation, each collected from an orchard with adjacent or nearby cattle operations.

Based on WGS, the samples of peaches and peach tree leaves collected adjacent to the poultry farm yielded *Salmonella* Alachua isolates that cluster with 2019 and 2020 chicken isolates (NCBI accession number SRR10031289, 0-2 SNPs difference) as reported in the NCBI database. Likewise, samples of peach tree leaves collected adjacent to the cattle operation yielded *Salmonella* Montevideo isolates that are genetically similar to 2018-2020 beef and cattle isolates (NCBI accession numbers SRR7171547, SRR9134232, SRR11311288, median of 16 SNPs difference) (Fig 1). The *Salmonella* positive findings, although not linked to cases of illnesses in this outbreak or related to any clinical isolates, stress the importance of observation and assessment of environmental conditions that could impact produce farms, including, but not limited to, adjacent land uses and suggest fugitive dust¹ from other agricultural/animal operations to be a plausible route of potential contamination of produce grown on adjacent or nearby lands. The large grower/producer cooperated with FDA throughout the investigation and is continuing to engage with FDA on the agency's findings and recommendations.

III. Factors Potentially Contributing to Contamination

The 2020 *Salmonella* Enteritidis outbreak linked to peaches from the United States represents a novel commodity/pathogen pairing. Although 101 cases of illness were reported in the U.S., this outbreak likely included thousands of illnesses accounting for under-reporting and under-diagnosis.² This previously undocumented commodity/pathogen pairing reinforces the approach that FDA took when developing the Produce Safety Rule. All commodities have the potential for contamination, including peaches, even if there is not a prior history of contamination of a specific commodity with a specific pathogen. Therefore, food safety interventions should be focused around practices and conditions that are known to be routes or sources of contamination. Investigational activities and findings associated with this outbreak support FDA's hypotheses about adjacent and nearby land use and possible routes of contamination in general and that fugitive dust may serve as a vehicle (route) of contamination to produce.

¹ Although there is no formal definition of fugitive dust, we use it here to mean the movement of dust particles throughout the environment (windblown) which may have human pathogens attached to them. Fugitive dust particles could act as vectors for pathogen movement and survival in the environment

² Under-diagnosis and under-reporting multipliers of 29 for *Salmonella* spp. from Scallan, E., Hoekstra, R.M., Angulo, F.J., Tauxe, R.V., Widdowson, M.A., Roy, S.L., Jones, J.L. and Griffin, P.M., 2011. Foodborne illness acquired in the United States—major pathogens. *Emerging infectious diseases*, 17(1), p.7.

Salmonella isolates were found in the tree canopy and from peach orchards, identified by tracebacks, on fields adjacent to animal operations. Multiple *Salmonella* isolates from product and leaf sampling conducted during this investigation genetically resembled previous chicken and cattle isolates, not associated with any known foodborne illnesses. We hypothesize that the adjacent animal operations (both poultry and cattle) were a likely contributing factor to the *Salmonella* Enteritidis outbreak – with fugitive dust as one possible route of product contamination. In addition, almond orchards were also identified to be in the vicinity of several identified peach orchards and almond operations have the capacity to generate significant dust due to the nature of their harvesting method in a relatively dry growing environment – as well as having the documented potential to harbor *Salmonella* populations.³

IV. Recommendations

In light of these findings, FDA encourages **all farms (including growers, harvesters, etc.)** to:

- Be cognizant of and assess risks that may be posed by adjacent and nearby land uses, especially as it relates to fugitive dust exposure from adjacent or nearby livestock and poultry.
- Assess growing operations to ensure that appropriate science- and risk-based preventive measures are in place, including applicable provisions of the FDA Food Safety Modernization Act (FSMA) Produce Safety Rule and good agricultural practices.
- Consider additional tools such as pre-harvest and/or post-harvest sampling and testing of products to help inform the risk assessment and clarify the need for specific prevention measures.
- When pathogens are identified through microbiological surveys, pre-harvest testing of produce, or post-harvest testing of produce implement industry-led root cause analyses to determine how the contamination likely occurred and then implement appropriate prevention and verification measures.
- Improve traceability through increased digitization, interoperability, and standardization of traceability records which would expedite traceback and help remove contaminated product from the marketplace more quickly, thereby preventing further illnesses. This is not only important for growers, but also critical for shippers, manufacturers, and retailers as well, to improve overall traceability throughout the supply chain.

FDA recognizes the interconnection between people, animals, plants, and their shared environment when it comes to public health outcomes, and we encourage collaboration among various groups in the broader agricultural community (e.g., produce growers, those managing animal operations, state and federal government agencies, and academia) to address this issue.

FDA continues to leverage agency resources to expand the information available to growers on the capacity for foodborne pathogen survival, persistence, and movement in and through the agricultural environment. We will continue to support stakeholders' efforts to develop ways to better understand and mitigate the risk of contamination. Food safety is a shared responsibility that

³ See Theofel, C. G., et al. (2020). "Microorganisms Move a Short Distance into an Almond Orchard from an Adjacent Upwind Poultry Operation." *Appl Environ Microbiol.* and Danyluk, M. D., et al. (2008). "Survival and growth of *Salmonella* Enteritidis PT 30 in almond orchard soils." *J Appl Microbiol* 104(5): 1391-1399.

involves food producers, distributors, manufacturers, retailers, and regulators. FDA is committed to working with these stakeholders to advance this critical work.

V. Relevant Links

[FDA Outbreak Investigation of Salmonella Enteritidis: Peaches \(August 2020\)](#)

[Prima® Wawona Recalls Bulk/Loose and Bagged Peaches Due to Possible Salmonella Risk](#)

[CDC Outbreak of Salmonella Enteritidis Infections Linked to Peaches](#)

[NCBI link to WGS information for a representative isolate](#)

[About the Produce Safety Network](#)

[About the CORE Network](#)

[About the Whole Genome Sequencing \(WGS\) Program](#)

[FSMA Produce Safety Rule](#)

[FSMA Preventive Controls for Human Foods Rule](#)

[FDA Bad Bug Book](#)