**Multiple *Salmonella* Serotype Infections Associated with Kratom**

April 2017-June 2018 Multiple counties/Multiple states

On February 22, 2018, the Centers for Disease Control and Prevention (CDC) notified the Minnesota Department of Health (MDH) that a clinical isolate of *Salmonella* I 4,[5],12:b:- from a Minnesota resident was indistinguishable by pulsed-field gel electrophoresis (PFGE) from isolates that were part of a multistate outbreak (1712MLJIX-1) linked to consumption of kratom powder. The isolate had MDH pattern designation JAV151 and CDC designation JKXX01.1478. Minnesota joined the ongoing national investigation. Additional serotypes and PFGE patterns of *Salmonella* were added to the case definition

during the course of the investigation if they were isolated from both clinical specimens and kratom-containing products.

Kratom is a plant native to Southeast Asia that is consumed for its stimulant effects and as an opioid substitute. It is typically consumed as a powder (often brewed in a tea), by chewing or smoking leaves, or encapsulated and ingested in pill form. It is also known by the names Thang, Kakuam, Thom, Ketom, and Biak, and is sold in some specialty stores selling tobacco or herbal products as well as through various online retailers. In 2012, the United States Food and Drug Administration (FDA) issued an import alert for unapproved drugs that included kratom, meaning that kratom can be detained without physical examination at the time of entry into the U.S. A second import alert in 2014 was issued for kratom-containing dietary supplements and bulk dietary ingredients.

A case was defined as a person with illness onset since January 1, 2017 from whom one of the following strains of *Salmonella* was isolated: *S.* Heidelberg (PFGE pattern JF6X01.0169), *S.* I 4,[5],12:b:- (pattern JKXX01.1478), *S.* Javiana (pattern JGGX01.2609), *S.* Okatie (patterns OKAX01.0001, OKAX01.0002, or OKAX01.0003), *S.* Thompson (pattern JP6X01.0684), or *S.* Weltevreden (JQPX01.0101).

Minnesota cases were initially interviewed with a routine surveillance questionnaire and then re-interviewed with a national outbreak-specific questionnaire focused on consumption of kratom and other herbal and/or pain relief products.

The Minnesota Department of Agriculture (MDA), regulatory agencies from other states, and FDA conducted product testing on leftover kratom collected from cases and kratom products collected from stores where cases reported purchasing kratom.

Overall, 199 cases from 41 states were identified in this outbreak (AL, AK [2], AZ [7], CA [13], CO [4], CT [2], DE, FL [8], GA [3], IA [3], ID [10], IL [5], IN [2], KS [2], KY [6], LA [3], MA [4], MD [3], MI [4], MN [11], MO [7], MS [2], NE, NC [7], ND, NV [2], NM, NY [11], OH [7], OK [7], OR [13], PA [3], SC [4], SD, TN, TX [4], UT [3], VA [7], WA [16], WI [6], WV). Nationally, illness onset dates ranged from January 11, 2017 to May 8, 2018. The median age of cases was 38 years (range, <1 to 75 years), and 52% were male. Of 132 cases with information available, 50 (38%) were hospitalized, and there were no deaths.

Among 103 cases for whom information was available, 76 (74%) reported consuming kratom in pills, powder, or tea. As of April 5, 2018, testing by FDA and various state regulatory agencies had identified 85 different PFGE patterns of *Salmonella* in 37 different kratom-containing products. FDA tested 66 samples of kratom-containing products from distributors and retail locations, of which 33 (50%) were positive for at least one strain of *Salmonella*.

In addition to the 11 Minnesota cases included in the national outbreak, 4 more cases were identified in Minnesota less than 1 month after the national investigation was closed; these cases are included in the summary data presented for the Minnesota cases.

Of the 15 Minnesota cases, 5 were serotype Thompson, 4 were Paratyphi B Var. L(+) Tartrate+, 3 were monophasic Paratyphi B variants, 2 were Weltevreden, and 1 was Okatie. The median age was 43 years (range, 20 to 64 years), and 60% were male. Illness onset dates ranged from April 21, 2017 to June 6, 2018. Four cases (27%) were hospitalized (range, 1 to 5 days), and none died.

Among 13 cases with information available, 11 (85%) reported consuming kratom prior to illness. Five cases reported purchasing kratom products through various websites, 5 purchased kratom at various tobacco and herbal stores in Minnesota, and 1 obtained kratom from a friend who purchased it at an unknown location.

MDA inspectors collected leftover product from two case households. Kratom powder from one household purchased from Website A was positive for *Salmonella* I 4,[5],12:b:- JAV151, matching the PFGE pattern of the case from whom it was collected; the leftover product was also positive for *S.* Thompson TMP72, *S.* Javiana JVN142, and *S.* Weltevreden WELT24. From the second household, Brand B kratom powder purchased from Website B was positive for *S.* Okatie OK3, matching the PFGE pattern of the case from whom it was collected; this product was also positive for *S.* Saintpaul STP63 and *S.* Weltevreden WELT15.

MDA inspectors also collected and tested multiple kratom products from Retail Location A in Minneapolis, where another case reported purchasing kratom products. All products collected from this store were negative for *Salmonella*.

Numerous kratom products from multiple retailers and distributors were recalled as a result of this investigation. Traceback efforts were complicated by the fact that kratom products enter the U.S. market through channels that are atypical for foods, such as through personal importation or false declaration of the product at the port of entry into the U.S. No common source for the implicated products was identified.

This was a multi-state outbreak of *Salmonella* infections associated with kratom and kratom-containing products. Minnesota cases were exposed to kratom products purchased both online and at retail locations. Product testing in Minnesota and other states identified a wide variety of kratom products contaminated with many different serotypes and PFGE patterns of *Salmonella*, leading to recalls of several products. A source of contamination was not identified.