



Final Summary of the Foodborne Outbreak Linked to Morel Mushrooms

Published Date: July 19, 2023

Over 50 individuals reported becoming sick with gastrointestinal (GI) symptoms after eating at Dave's Sushi in Bozeman, MT between March 28 and April 17, 2023. As previously reported, two of these individuals died and three were hospitalized. Patrons who reported becoming ill were aged 18 to 74 years, and most individuals became ill within three hours following their meal at the restaurant. Diarrhea, nausea, vomiting, and abdominal pain were among the most common symptoms of the reported cases.

The Gallatin City-County Health Department (GCCHD) and the Montana Department of Public Health and Human Services (MT DPHHS) were able to reach and interview 63 people who dined at the restaurant during the dates in question. Of those, 41 were patrons who reported becoming ill after dining at the restaurant (cases), and 22 were patrons who dined at the restaurant but did not become ill (controls). An analysis of the interview findings was used to compare the menu items eaten by the two groups and determine which food items were associated with illness. The public health departments worked with the Centers for Disease Control and Prevention (CDC) to analyze the study results.

Study results indicated that consuming morel mushrooms at the restaurant was strongly associated with developing GI illness. Additionally, individuals who reported consuming a greater quantity of sushi containing morels were more likely to develop illness compared to those who reported consuming fewer pieces.

MT DPHHS and GCCHD also worked with the U.S. Food and Drug Administration (FDA) to perform testing on food samples. DNA sequencing was performed on the morel mushroom samples, and identified the species as *Morchella sextelata*, a type of true morel. Samples of morel mushrooms collected from the restaurant were also screened for pesticides, heavy metals, bacterial toxins, and pathogens. No significant findings were identified.

The toxins in morel mushrooms that may cause illness are not fully understood. However, it is known that using proper morel mushroom preparation techniques, including cooking, can help reduce toxicity and risk of illness. According to documents provided by the restaurant, the morel mushrooms served during March and April 2023 were prepared raw or only lightly cooked, depending on the date of preparation.

A subset of the CDC analysis compared illness from dining at the restaurant on two dates: April 8, when the morels reportedly underwent some cooking process by being marinated in a sauce immediately after the sauce had been boiled, and April 17, when the morels were uncooked and marinated in a sauce that had not been boiled. Consumption of morels on both dates was associated with developing illness. However, consumption of morels was more strongly associated with developing illness on April

17, when the morels were reportedly prepared without any cooking process. Most individuals with severe outcomes dined at the restaurant on April 17.

An FDA traceback investigation showed that restaurants in other states received morel mushrooms from the same supplier during the same timeframe as Dave's Sushi. A more thorough investigation into a subset of these restaurants showed that all six of the restaurants interviewed reported cooking, sautéing, or otherwise thoroughly heating the mushrooms before serving. None of the restaurants reported receiving any consumer complaints associated with developing illness after eating morels at the respective restaurant.

The findings of this investigation are subject to at least two limitations. First, this investigation could not determine what specific characteristic of the morel mushrooms caused the outbreak. There may have been differences in how the morel mushrooms were stored and prepared on April 8 and 17 that were not identified through the outbreak investigation. Storage of the morel mushrooms, in addition to the differences in cooking method described above, could have played a role in making people sick. Second, the specific toxin or pathogen in the morel mushrooms served at the restaurant is unknown and could not be confirmed through laboratory testing. However, the signs and symptoms of illness reported were consistent with what could result from eating morel mushrooms that were not properly handled, prepared, or cooked. There are scientific gaps in knowledge regarding morel mushrooms in the wider public health, medical toxicology, and mycology realms that need further research in order to better understand how morel mushrooms affect human health. Based on the strong epidemiological data, morel mushrooms were the most likely cause of the outbreak but there may be other contributing factors that were not identified during the investigation and that remain unknown.

Anyone eating, selling, or serving morel mushrooms should use caution when doing so. There are varieties of poisonous wild mushrooms that look very similar to morel mushrooms.

Public health officials recommend those preparing morels should confirm the identity of each mushroom, and consult with a knowledgeable expert, as poisonous species have been known to grow near edible species in the wild. Choose mushrooms that are dry and firm, and avoid those that are bruised, discolored, slimy, or otherwise spoiled. Morel mushrooms should be refrigerated at a temperature of 40°F or below, in breathable type packaging, such as a paper bag. Morels should be cooked thoroughly prior to consumption, as this is likely to reduce toxin levels present in the mushrooms.

Individuals who become ill after consuming morels should contact their healthcare provider immediately and/or call the Poison Control Hotline at 1-800-222-1222.

Publishing Entities:

*Montana Department of Health and Human Services
Gallatin City-County Health Department*