

Preventing Foodborne Illness: Yersiniosis¹

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What is yersiniosis?

Yersiniosis is an infectious disease caused by the consumption of contaminated food contaminated with the bacterium *Yersinia*. Most foodborne infections in the US resulting from ingestion of *Yersinia* species are caused by *Y. enterocolitica*. Yersiniosis is characterized by common symptoms of gastroenteritis such as abdominal pain and mild fever (8). Most outbreaks are associated with improper food processing techniques, including poor sanitation and improper sterilization techniques by food handlers. The disease is also spread by the fecal–oral route, i.e., an infected person contaminating surfaces and transmitting the disease to others by not washing his or her hands thoroughly after going to the bathroom. The bacterium is prevalent in the environment, enabling it to contaminate our water and food systems. Outbreaks of yersiniosis have been associated with unpasteurized milk, oysters, and more commonly with consumption of undercooked dishes containing pork (8). Yersiniosis incidents have been documented more often in Europe and Japan than in the United States where it is considered relatively rare. According to the Centers for Disease Control and Prevention (CDC), approximately one confirmed *Y. enterocolitica* infection per 100,000 persons per year is reported in the US (3). However, this approximation may be an underestimate since only serious cases are reported. Further, the low incidence of *Yersinia* in the US food supply may additionally be attributed to the long incubation time and misdiagnosis of patients with *Y. enterocolitica* infection, along with the inability to identify the source of infection (4).



Figure 1. *Yersinia enterocolitica* bacteria growing on a Xylose Lysine Sodium Deoxycholate (XLD) agar plate.

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What is *Y. enterocolitica*?

Yersinia enterocolitica is a small, rod-shaped, Gram-negative, psychrotrophic (grows well at low temperatures) bacterium. There are approximately 60 serogroups of *Y. enterocolitica*, of which only 11 are infectious to humans. Of the most common serogroups—O:3, O:8, O:9, and O:5,27—to have been isolated in Europe, Japan, US, and Canada (2, 5), the serogroup associated with most incidents of *Y. enterocolitica* infections is O:3 (6).

Yersinia enterocolitica may be found in food products, although it is difficult to isolate the microorganism from food samples (4). *Yersinia enterocolitica* can grow between -2°C and 45°C (6); growth is slower at lower temperatures,

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(doubling time is 34 minutes at 30°C, compared to 5 hours at 7°C) (8). It can thrive in refrigerated/cooked foods for extended periods as long as there are available nutrients and low competition with other psychrotrophic bacteria. Indeed, the organism can persist extended periods in a variety of prepared foods (8), including vacuum-packed meat, boiled eggs, boiled fish, pasteurized milk, cottage cheese, and tofu. *Yersinia enterocolitica* can also grow on refrigerated seafood, including oysters, raw shrimp, and cooked crabmeat. It can survive in frozen foods for extended periods, and it can tolerate both acidic and alkaline pH, from 4 to 10, with the optimum pH for growth being 7.6 (8).

This organism has been isolated from clinical specimens including feces and sputum (8), but it is not part of the normal human microflora. Rather, the prevalence of *Y. enterocolitica* in soil, water, and animals offers multiple routes for it to enter the food supply chain. Pig is the most common animal consumed by man that harbors pathogenic *Y. enterocolitica*. The organism is also isolated from various other animals including birds, beavers, cats, and dogs. The pathogenic serogroups O:3 and O:9 are harbored by pigs and are frequently found in their fecal matter, on the tonsils and tongue, and as surface contaminants in pig carcass (6). Consumption of raw or undercooked pork products has been blamed for many outbreaks of yersiniosis, along with poor sanitation and improper sterilization techniques.

How is *Y. enterocolitica* transmitted?

Although outbreaks of yersiniosis are uncommon and sporadic in nature, foodborne outbreaks have been associated with consumption of contaminated food or water, and in places of high pork consumption (2, 5). Consumption of untreated water or unpasteurized milk can transmit yersiniosis (3). Although less frequently, the pathogen is also transmitted through the fecal–oral route, resulting from improper hand washing and poor hygiene (8). Cross-contamination of cooking surfaces including cutting boards and utensils or consumption of raw or undercooked pork can transmit yersiniosis. Outbreaks of yersiniosis in infants have been reported in the US and were found to have been associated with preparation of chitterlings (3). Cross-contamination from improper hand washing by caretakers preparing chitterlings before caring for the infants was often cited. Rarely, a transfusion of blood contaminated with *Y. enterocolitica* can result in sepsis (3).

What are the symptoms of yersiniosis?

Yersiniosis is characterized by gastroenteritis, with diarrhea and/or vomiting, fever, abdominal pains, and skin rashes (8). On average, symptoms appear within 3–7 days of eating contaminated food. Host factors such as age and the physical state of the patient, and the serogroup of *Y. enterocolitica* determine the appearance of an infection (4, 6). Children under the age of five are more susceptible to symptomatic infections of yersiniosis (8). Less than 10% of the infected children may have bloody stools. The illness can range from self-limiting to fatal systemic infection. Yersiniosis may last from a few days to three weeks (8). If it progresses to chronic enterocolitis, it may last up to several months.

What are the long-term effects/ complications from yersiniosis?

Most cases of yersiniosis are uncomplicated and self-limiting. In some instances, lower abdominal pain associated with yersiniosis mimics the symptoms of appendicitis, resulting in misdiagnosis. Yersiniosis has also been misdiagnosed as Crohn's disease (8). Reactive arthritis may occur after 1–3 weeks of a serious *Y. enterocolitica* infection. Bacteremia, or entrance of the bacteria into the blood stream, is a rare complication from yersiniosis. In immunocompromised individuals, yersiniosis can lead to meningitis and inflammation of the skin (7).

Who is most at risk?

Yersiniosis mostly affects infants, children and teenagers, although it can also occur in adults. The infectious dose of *Y. enterocolitica* is estimated to be from 10,000 to 1,000,000 cells (8). In infants, children, adolescents, and the elderly, a lower number of *Y. enterocolitica* may cause infection. Likewise, a lower level of *Y. enterocolitica* may lead to infection of immunocompromised individuals and those with gastric hypoacidity, where stomach acids are unable to effectively act as a barrier to infection (8). Individuals with hereditary hemochromatosis (high iron levels in the body) are also more susceptible to infection by *Yersinia* (1), as iron is an important growth factor for the organism.

How can you prevent yersiniosis?

- Good hygiene should be practiced during food processing and food preparation; poor sanitation and improper sterilization techniques by food handlers are a known reason for *Y. enterocolitica* outbreaks.

- The optimum growth temperature of *Y. enterocolitica* is 28°C–29°C; raw and cooked meats should be chilled to reduce growth. However, it can also grow in refrigerated foods. Refrigeration of food products should not be considered as the only control measure for this pathogen. Food should be cooked properly before consumption.
 - Wash raw fruits and vegetables.
 - Consume pasteurized milk and dairy products, not raw milk products.
 - Wash hands thoroughly with warm water and soap before and after touching any raw meat products.
 - Ensure proper sanitation and hygiene during rearing, harvesting, processing, and transportation of pigs.
 - Avoid consumption of raw or undercooked pork products.
 - Preparation of raw chitterlings is a known high-risk behavior for *Y. enterocolitica* infection.
 - Decrease the risk during cleaning and cooking of chitterlings by buying pre-cooked chitterlings or boiling chitterlings them for 5 minutes before cleaning and cooking.
 - After handling raw chitterlings, clean hands thoroughly with soap and water before touching infants or their toys. Infants should never be around an area of chitterling preparation.
 - Thoroughly clean all cutting boards, countertops, and utensils with soap and hot water after preparing raw meat. All surfaces and equipment should be properly cleaned before and after any food is prepared to prevent cross contamination from microorganisms.
 - Hygienic conditions should be maintained in food processing facilities.
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Endnotes

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