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Vibrio contamination in raw oysters controlled by post-harvest treatments

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***V. parahaemolyticus* a leading cause of human gastroenteritis associated with seafood consumption**

Prompt refrigeration and various non-thermal treatments ensure the safety of raw oysters. Photo by William Folsom, National Marine Fisheries Service. Courtesy of National Oceanic and Atmospheric Administration.

Seafood is highly perishable because it can harbor microorganisms that exist in the marine environment. Although the majority of indigenous microorganisms associated with seafood present no threat to human health, human pathogens such as *Vibrio parahaemolyticus* have frequently been isolated from a variety of finfish and shellfish.

V. parahaemolyticus

V. parahaemolyticus is a gram-negative bacterium that occurs naturally in the marine environment. Shellfish, which filter water for nutrients, can accumulate *V. parahaemolyticus* from the surrounding water.

This bacterium is the leading cause of human gastroenteritis associated with seafood consumption in the U.S. and an important seafood-borne pathogen throughout the world. Consumption of raw or undercooked shellfish, particularly raw oysters, contaminated with *V. parahaemolyticus* can lead to acute gastroenteritis characterized by diarrhea, vomiting, abdominal cramps and, sometimes, low fever.

The illness is often self-limited, but the infection can lead to the development of septicemia that is life-threatening to people with underlying medical conditions such as liver diseases or immune disorders. People with such disorders should avoid eating raw or undercooked oysters.

Raw shellfish

The U.S. produces more than 12,245 mt of oysters each year. Most of them are sold live or shucked without further processing. Outbreaks of *V. parahaemolyticus* infection in the U.S. have mainly been linked to raw shellfish consumption.

Four large outbreaks involving more than 700 illnesses occurred in the Gulf Coast, Pacific Northwest and Atlantic Northeast regions of the U.S. between 1997 and 1998. The U.S. Centers for Disease Control and Prevention estimated that 4,500 cases of *V. parahaemolyticus* infection occur each year in the United States.

The distribution of *V. parahaemolyticus* in marine environments is known to relate to water temperature. The organism is rarely detected in seawater until water temperatures rise to 15 degrees-C or higher. Therefore, it is more likely to detect *V. parahaemolyticus* in oysters harvested in the summer than in the winter. In the U.S. state of Mississippi, the harvest of oysters for raw consumption is limited from mid-September through April to minimize incidences of *V. parahaemolyticus* illness.

Post-harvest handling

The levels of *V. parahaemolyticus* in oysters at the time of consumption depend largely on post-harvest handling. Like most human pathogens, *V. parahaemolyticus* can multiply rapidly upon exposure to elevated temperatures. Populations of *V. parahaemolyticus* in oysters can increase to levels 50- to 790-fold their original levels within 24 hours of harvest if oysters are exposed to 26 degrees-C.

Therefore, the National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish established time-to-temperature regulations to limit the growth of *V. parahaemolyticus* in post-harvest oysters. Shellfish harvested for raw consumption must be cooled to 10 degrees-C within 10, 12 and 36 hours of harvest when the average monthly maximum air temperature is 27 degrees-C or greater, 19 to 26 degrees-C, or 18 degrees-C or less, respectively. The cooling can be achieved with ice, mechanical refrigeration or other approved means capable of sufficiently lowering temperature.

Processing

In addition to proper refrigeration upon harvest, low-temperature pasteurization, freezing, irradiation and high-pressure processing reduce *V. parahaemolyticus* contamination in oysters post harvest. *V. parahaemolyticus* is heat-sensitive and can easily be inactivated by a thorough heating process.

A low-temperature pasteurization process involving heating shellstock oysters in 55.0 degrees-C water for 10 minutes to achieve an internal temperature of 48.0 to 50.0 degrees-C for five minutes has been developed for eliminating *V. parahaemolyticus* from oysters. Oysters processed with the low-temperature pasteurization retain a “raw” quality with a shell life in ice of three weeks as long as the internal temperature of the oysters does not exceed 52.5 degrees-C. The pasteurization process also has an added benefit in oyster shucking because the oysters are likely killed during the heat treatment.

Besides heat processing, frozen storage can also be utilized by the shellfish industry to reduce *V. parahaemolyticus* contamination in raw oysters. A recent study conducted at the Seafood Research and Education Center of Oregon State University demonstrated that a process of flash freezing at minus-95.5 degrees-C for 12 minutes, followed by frozen storage at minus-21 degrees-C for five months could achieve greater than 3.52-log reductions of *V. parahaemolyticus* in half-shell Pacific oysters.

Non-thermal processes, including irradiation and high-pressure processing, have also been developed for inactivating *V. parahaemolyticus* cells in oysters. Exposure of raw oysters to Cobalt-60 gamma radiation at doses of 1.0 to 1.5 kGy reduced *V. parahaemolyticus* to non-detectable levels with no apparent changes in sensory characteristics.

A high-pressure treatment of 300 megapascals (MPa) for 180 seconds could reduce clinical strains of *V. parahaemolyticus* in oysters by greater than 5-log units. The efficacy of high-pressure processing in inactivating bacteria is dependent on the processing temperature. A 5-log reduction of *V. parahaemolyticus* in live oysters could also be achieved by a reduced treatment time of 120 seconds at 300 MPa when the processing temperature was raised to 40 degrees-C.

High-pressure processing can also be applied for oyster shucking by destroying the adduct muscle under higher pressures. A process of 240 to 275 MPa for one to two minutes was reported capable of shucking Pacific oysters with minimum changes in appearance.

Low-temperature depuration

Currently, the Seafood Research and Education Center of Oregon State University is developing a low-temperature depuration process to decontaminate *V. parahaemolyticus* in oysters for raw consumption. The advantages of such a process over the already developed post-harvest processes is that oysters will not be killed during the decontaminating process, which would allow the shellfish industry to deliver live raw oysters safe for consumption.

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