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Human enteric viruses in shellfish, part 2

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Noroviruses a leading cause of gastroenteritis

> Since many of those who consume shellfish contaminated with noroviruses become ill, sanitation programs attempt to control the viruses through growing, harvesting and processing standards.

Bivalve molluscan shellfish filter large volumes of water as part of their feeding activities, and in doing so can accumulate and concentrate bacteria, viruses and other types of pathogens from human fecal pollution and other sources.

Norovirus infections

Among human enteric viruses, noroviruses are the leading cause of epidemics or sporadic cases of gastroenteritis in all age groups of humans. Victims typically exhibit diarrhea and vomiting for 24 to 48 hours after an incubation period of 18 to 36 hours.

Members of the Caliciviridae family, noroviruses are characterized into five genogroups: GI through GV. Three groups – GI, GII and GIV – cause disease in humans. Within genogroups, they are further characterized into clusters (eight for GI and 17 for GII), and within clusters, the individual norovirus assigned to an outbreak is referred to as a strain. GII.4 cluster strains are the most common in outbreaks.

Attack rates are relatively high, often exceeding 50 percent, meaning that over half the people who consume the contaminated food became ill. Only a limited number of attack rates worldwide have been reported for molluscan shellfish. Attack rates of 30, 58, 63, 68 and 78 percent have been reported in shell oysters; with 58 percent in frozen half-shell oysters and 74 percent in mussels. Ill people shed norovirus at high levels in waste. Additionally, post-symptomatic virus shedding can continue for some time after disease resolves. For example, norovirus shedding in an experimental human infection model lasted a median of 28 days, with a range from 213 to 56 days, and most subjects were no longer symptomatic by day 4.

Viral detection

Strains of human noroviruses do not grow or poorly grow in vitro, and their detection in food matrices relies on molecular techniques. However, further standardization of molecular methods will be necessary before they are widely adopted within regulatory frameworks and routinely implemented in food analysis. A standard method for virus detection and quantification in molluscan shellfish is currently available via the International Organization for Standardization (ISO/TS 15216-1:2013, 2013), and adoption of the viral standards into European Union legislation is being considered.

Norovirus control

Shellfish sanitation programs worldwide attempt to reduce the incidence of norovirus illness through the establishment of growing water standards, harvesting and processing sanitation standards, distribution controls and consumer education programs. However, human activities such as swimming, land runoff, heavy rain and storms, commercial and recreational boating, marinas and sewage discharges from commercial and domestic sources can rapidly introduce noroviruses to molluscan shellfish-growing areas.

By the time a regulatory agency can identify a potential or actual public health problem and implement corrective action, shellfish may have been harvested and entered commerce. Attempts to identify the location of the contaminated shellfish and initiate a complete product recall are usually difficult.

An example of the difficulty in identifying norovirus contamination prior to harvest occurred in the United States in 1993. The outbreak, which involved oysters from an approved growing area, had a 63 percent attack rate. Microbiological sampling showed the growing area met all standards. There was no environmental source of pollution identified. Sanitation procedures at the oyster-processing facilities where seafood dealers purchased the oysters met all state and federal health standards.

Incorrect assessment has also caused problems. It has been known for over 40 years that bacteria and viruses exhibit differences in terms of concentration, accumulation and depuration from contaminated shellfish. As a consequence, the absence of virus contamination cannot reliably be deduced from the failure to detect bacterial contamination. However, risk management assessment and the management of harvesting areas continue to rely on bacteriological standards like *Escherichia coli* values, despite the fact they have been proven unreliable for indicating viral presence.

Norovirus outbreaks

Current wastewater treatments fail to ensure the complete removal of viral pathogens that can be discharged into fresh, marine and estuarine waters and therefore contaminate shellfish-growing waters. Viral elimination depends on a wide array of factors, including temperature, solar radiation, adsorption, enzymatic destruction and predation by bacteria and protozoa. The filter-feeding nature of bivalves and their often raw or slightly cooked method of consumption make molluscan shellfish one of the most common vehicles of foodborne illnesses.

Investigations of disease outbreaks linked to molluscan shellfish have been reported in the scientific literature, but only a few countries systematically collect and report such data through a disease surveillance system. A systematic review was conducted by scientists in Greece to investigate viral outbreaks associated with mollusks and explore their distribution in different countries.

Six databases – Medline, Embase, Scopus, PubMed, Eurosurveillance and SpringerLink – and the ProMED global electronic reporting system were searched. From 1980 to July 2012, about 360 molluscan-borne viral outbreaks, alongside nine ProMED reports involving shellfish consumption, were identified.

More than half of the outbreaks, 63.6 percent, were reported in Japan. The rest were reported in Italy (7.7 percent), the United States (4.6percent), France (4.1 percent), New Zealand (2.7 percent), Sweden (1.6 percent), Spain (1.6 percent), United Kingdom (1.4 percent), Singapore (1.1 percent) and Australia (1.1 percent). In 8.2 percent of the outbreaks, the country of the epidemic was not reported.

The most common vehicle of infection was norovirus, which was involved with 83.7 percent of the incidents. The shellfish species implicated in the viral outbreaks by the scientific literature and ProMED were oysters (58.4 percent), clams (22.6 percent), mussels (0.5 percent) and cockles (1.1 percent).

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