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Viruses and Parasites Associated with Seafood

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Viral contaminants

There are more than 110 different viruses known to be excreted in human feces and collectively called the "enteric viruses". Viruses survive better at low temperatures and are inactivated at high temperatures. Viruses can remain viable for long periods of time in seawater and have been shown to survive as long as 17 months in marine sediment. Viruses associated with sediment are as infectious to animals as those that are freely suspended. Marine sediment acts as a reservoir of viruses, which may be resuspended by any kind of turbulence, such as boating, storms and dredging. Rains can also increase viral concentration in the water by increasing land runoff and by release of sewage from overburdened treatment plants.

Virus uptake and elimination by shellfish

Viruses have been isolated from hard clams, oysters, mussels, soft clams, crabs, cockles, lobster and conch. In filter-feeding molluscs, the viruses can become concentrated at a level higher than the surrounding water. The viruses do not multiply in bivalves, but accumulate in the liver-like digestive gland.

Carnivorous shellfish, such as, crabs and lobster can accumulate viruses by contact with contaminated seawater and/or by consuming contaminated bivalves. Viruses are generally present in crabs at a level below that of the water. The highest concentrations of viruses are found in the inedible portions of crabs. However, the potential health hazard should not be overlooked since tissue contamination could occur when crabs are prepared for consumption.

A number of experiments on the efficiency of viral depuration have been conducted and have resulted in a range of conclusions, although the more recent studies generally do not support the use of depuration for viruses.

Detection and prevention of viruses

Fecal coliforms are used as indicator bacteria to predict the possible presence of viruses and other pathogens in shellfish. The water standard for harvesting mollusks is 14 fecal coliforms or less per 100 ml of water. However, it is generally accepted that coliforms do not accurately indicate the presence or absence of viruses. Recently PCR methods have been used for the detection of viruses from shellfish as well as water. Most of the enteric viruses donot grow in cell culture and hence traditional virological methods cannot be used for its detection. Generally, bacteria do not live as long as viruses in the marine environment. Fecal coliform standards only apply to filter-feeding mollusks. The regulations do not apply to commercial harvesting of crabs and lobsters. Although viruses accumulate in the nonedible portions of crabs and lobsters, they have caused viral illness due to contamination of edible tissues while cooking. Mobile shellfish, such as crabs and lobsters, also present a problem since they can accumulate viruses in polluted waters and move to cleaner areas and act as vectors of viral disease.

Some cases of illness have been linked to insufficiently cooked shellfish. Most viruses

(excluding Hepatitis A) are inactivated when the internal temperature of the mollusk reaches 60°C, which requires 4 to 6 minutes of steaming. A common cooking practice is to steam mollusks only until the shell opens. It has been demonstrated that shells open after only about 1 minute of steaming, which is not sufficient time to inactivate all of the viruses.

Hepatitis A

Hepatitis A virus (HAV) is classified with the enterovirus group of the Picornaviridae family. Hepatitis A is 27 nm in diameter and has single-stranded RNA. The first reported outbreak of seafood-borne (oysters) hepatitis A occurred in Sweden in 1955. Raw and steamed hard clams, oysters, mussels and soft clams have been implicated in outbreaks of hepatitis A. Symptoms of hepatitis A infection usually begin within 4 weeks (range: 2 - 6 weeks) of exposure to the virus. The initial symptoms are usually weakness, fever, malaise and abdominal epigastric pain. As the illness progresses, the individual usually becomes jaundice, and may have dark urine. The severity of the illness ranges from very mild (young children are often asymptomatic), to severe, requiring hospitalization. The fatality rate is low (<0.1%), and deaths primarily occur among the elderly and individuals with underlying diseases.

Hepatitis A appears to be more resistant to heat than other viruses. Hepatitis A viruses in infected oysters were inactivated after heating at 140°F for 19 minutes. Therefore, molluscs which are steamed only until the shells open are not exposed to heat long enough to inactivate hepatitis A viruses.

Norwalk Virus

Norwalk virus is the prototype of a family of unclassified small round structured viruses (SRSVs), which may be related to the caliciviruses. They contain a positive strand RNA genome of 7.5 kb and a single structural protein of about 60 kDa. Illness from norwalk virus has been associated with eating clams (both raw and steamed) and oysters. Norwalk virus causes nausea, vomiting, diarrhea, abdominal cramps and occasionally fever in humans. Symptoms of gastroenteritis usually begin within 40 hours (range 12 - 72 hours) of consuming contaminated food. Gastroenteritis caused by norwalk virus is a self-limiting illness which usually persists < 48 hours, but can last long as one week.

Poliovirus

Poliovirus is one of a group of related viruses known as the enteroviruses. These are small, non-enveloped, isometric viruses that multiply in the gut mucosa and are transmitted from person to person by the fecal-oral route. They are spread throughout the body via the blood stream. Most infections occur during childhood, and they are usually transient but produce lifelong immunity. Clinical syndromes are generally mild, but occasional infections may cause serious disease e.g. paralytic poliomyelitis, meningitis, or myocarditis

Some of the more frequently recovered viruses from shellfish are the polioviruses because of the common practice of immunizing children against polio. The vaccine consists of live attenuated viruses that replicate in the intestine but produce few or no clinical symptoms. Children who have been immunized excrete viruses (from 1000 to 1,000,000 viruses/gram feces) for several days after the vaccine is administered. Since the viruses in the vaccine are modified, they present no health hazard if consumed by humans.

Parasites in seafood

Several parasites found in fish can infect humans as nontraditional hosts. The mode of entry into humans is by ingestion of raw or undercooked infected fish. Proper cooking or freezing prevents

transmission of ingested human pathogenic parasites. Some parasites are found only in tropical regions. The prevalence and importance of parasitic infections vary markedly depend on local risk factors and conditions

Diphyllobothriasis

The causative agent *Diphyllobothrium latum* lives in the small intestine of man and produces gastro-intestinal disturbances and anemia. The eggs are operculated and are liberated through feces in water. The eggs develop into a coracidium and are ingested by cyclops. In the intestine of the Cyclops the coracidium develops into a procercoid. Fresh water fish ingests the cyclops possessing procercoid. The procercoid changes into pleurocercoid. This is also called as sparganum. Man gets infection by ingestion of insufficiently cooked fish containing pleurocercoid. Thus the life cycle is completed. Salting, pickling or smoking does not destroy pleurocercoid and therefore remain infective to man. Laboratory diagnosis consists of microscopic examination of the patient's stool to demonstrate characteristic operculted eggs. Fish should not be consumed with out thorough cooking.

Anisakiasis

One of the most important nematode diseases of humans acquired from fish is anisakiasis or anisakidosis. Anisakis simplex is the most frequently associated *Contracaecum osculatum* species. Followed by *Pseudoteranova dicipens* has rarely been reported. This disease is caused by the larval stages of worms. These worms are natural parasites of whales, dolphins, porpoises, seals, sea lions, herring, cod, mackerel, salmon, squid, halibut, flatfish, etc. Major source of infection is traditional preparations such as raw herring, ceviche, sushi and sashimi. In man symptoms include abdominal pain, fever, nausea, vomiting, etc. Clinical diagnosis is based on the history of consumption of raw/ semi raw/ smoked/inadequately cooked fish. Eiosinophilia and leucocytosis are also seen on blood examination. Larvae can be demonstrated in the affected tissues. Serological tests may be of some value in the diagnosis. Endoscopic removal of the larvae from the stomach of the patients with four to six hours of ingestion may give relief. Surgical resection of the damaged wall can be resorted to. Control consists of evisceration of fish immediately after catch freezing the fish at -20 degrees Celsius. Avoiding consumption raw under cooked smoked or mildly salted fish will go a long way in the prevention of anisakiasis.

Dioctophymiasis

Dioctophyma renalae is a very large nematode producing renal colic hematuria, pyuria, and retention of urine due to the presence of parasite in the urinary system. Infection occurs by consumption of raw uncooked fresh water fish crayfish or crustacean containing infective larvae of the nematode. Microscopic examination of the urine for the presence of eggs of *D.renalae* confirms the clinical diagnosis. Surgical removal of the affected kidney is the only treatment. If both kidneys are infected the prognosis is grave.

Gnathostomiasis

Gnathostomiasis is infection by the nematode *Gnathostoma spinigerum*, and rarely by *G. hispidum*. Human gnathostomiasis is endemic in Southeast Asia (Thailand, Malaysia, Vietnam) and Japan and China. It has been reported from India, the Philippines, and Israel.

The life cycle of *G. spinigerum* includes two freshwater hosts: *Cyclops* and the freshwater fishes, which normally feed on these, infected crustacea. Eating raw, poorly cooked, or marinated fish and meat infect man. The common animal hosts are dog and cat. Histologically in man, while the larva are moving, the tissue damage appears to be mainly

mechanical. There are edema, small hemorrhages, and a moderate cellular reaction. However, once the parasite is stationary, there is an intense inflammatory response, with many eosinophils. The periphery is walled off by granulomatous and fibrous tissue.

Cross-reactions with other nematodes make serological diagnosis unreliable: recovery of the worm is the accurate way to make the diagnosis. Symptoms develop within 24 to 48 hours after eating infected fish or meat. There will be nausea, salivation, vomiting, flushing, pruritus, urticaria, and upper abdominal pain. At this stage there is a marked eosinophilia, which may reach 90%. As the larvae escape from the stomach, their movement within the abdomen or chest, or later in the muscles, may cause brief but sharp pain. When the worm is in the lung there may be blood-streaked sputum or a pneumothorax. Three or four weeks after ingestion the worm is in the subcutaneous tissues and its migration can be observed. The worm seldom migrates deeply once it has reached the subcutaneous tissue. At this stage the systemic symptoms decrease, the eosinophilia is less marked, and the illness becomes chronic. Intermittent subcutaneous swellings appear, single or multiple, depending on the number of larvae migrating. They may last as long as 10 days and recur every 2 to 6 weeks, but gradually the episodes subside and the intervals are increased. When the larva enters specific organs, the clinical symptoms depend entirely on the situation.

Trematode infections

Thirty-three species of digenetic trematodes have been listed as transmissible to man through consumption of fish, crustacea or molluscs. Among these members of Heterophydiae family are significant. They are very small trematodes that inhabit the intestine of birds and mammals. The infective stage (metacercaria) can be found in a wide variety of fish. These parasites acquired by eating raw, marinated or improperly cooked fish are frequently reported from human infections. Accumulation of large numbers of these parasites in the small intestine may cause inflammation, ulceration and necrosis. These trematodes are represented by the following species *Heterophyes heterophyes, Paragonimus werstermonia, Metagonimus yokogawai, Clonorchis sinensis, Opisthorchis sps.*,etc. The pathology caused by these parasites is similar and the risk cholangio- carcinoma (gall bladder cancer) may be high in chronic cases.

Nanophyetes salmoncola is a trematode parasite in the intestine of dogs and many wide piscivorous mammals. The disease however does not arise directly from the trematode but instead is due to a rickettsial hyperparasite "*Neorickettsia helmonthoeca*" which is pathogenic for dogs. The presence of large number of parasites can cause gastroenteritis popularly called as salmon poisoning. Nanophyetiasis is transmitted by the larval stage (metacercaria) of a worm that encysts in the flesh of freshwater fishes. In anadromous fish, the parasite's cysts can survive the period spent at sea. Raw, underprocessed, and smoked salmon and steelhead are implicated in disease.

Acanthocephalans or spiny-headed worms have been reported from humans. The adults of *Chorinosoma stromosum* are found in the stomach of pinnepids (sealions). The tiny crustacean intermediate hosts and fish, which eat the fish, are sources of infections.

Transient infection with fluke *Isoparorchis hypselobagri*, a similar parasite to *Fasciola*.has been reported as relatively common in the state of Manipur in Assam, India. Here the infection is due to ingestion of the raw swim bladders of catfish infected with the parasite.