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The Shellfish Corner -- Vibrios and Shellfish

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VIBRIOS AND SHELLFISH

By Michael A. Rice*

Shellfish aficionados who enjoy the succulent taste of freshly shucked shellfish and appreciate the subtle differences in tastes of different species of shellfish grown in different estuaries under different conditions (often known as the *terroir* of the shellfish similar to the *terroir* of a fine varietal wine) are willing to pay a considerable price premium for the peace of mind of having a very low probability of getting sick from a sewage polluted half-shell bivalve. Unfortunately, however, it is not just sewage pollution that can cause sickness and erosion in consumer confidence in the safety of shellfish.

On several occasions, shellfish consumers have become ill on raw shellfish that have been infected with various types of vibrio bacteria that are not sewage-related but rather are found generally in the environment, particularly in warmer water areas. Not all vibrios are pathogenic or have the capability of causing disease, but there are certain strains such as *Vibrio cholerae*, *V. vulnificus* and *V. para-*

On the last installment of *The Shellfish Corner* I provided a rationale for the existence of nationally-mandated shellfish sanitation programs as a major driver of the growing popularity and demand for oysters and other molluscan shellfish.



Maintenance of a good cold-chain from harvest to the consumer is the best policy for maintaining healthy and wholesome shellfish. Here Perry Raso and Colby Doyon of the Matunuck Oyster Bar prepare a dozen oysters for aficionados in Rhode Island. (Photo courtesy of the Matunuck Oyster Bar).

haemolyticus that have been known to cause disease in humans. Although rare in occurrence, over the last ten years or so a growing number of illnesses reported by the United States Centers for Disease Control (CDC) were attributed to vibrios associated

with consumption of raw shellfish that had most probably not been handled properly after harvest. Recently, this increase in vibrio-related illnesses has been linked by Vezzulli and others in a 2013 article in the journal *Microbial Ecology* to the rise in


global ocean temperatures. And a recent 2014 volume titled *Vibrio Ecology, Pathogenesis and Evolution* edited by Rita Colwell and Daniela Ceccarelli provides a comprehensive review of the diverse nature of the various vibrios and their niches in marine environments. Frequently the vibrios serve as decomposers in the marine environment, breaking down detritus. Many of the more pathogenic strains can be persistent in the environment, and certain strains will associate with specific types of higher marine organisms such as zooplankton or crustaceans.

Depuration, or the placing of shellfish into clean filtered water for a time, has been suggested as a means for reducing the load of pathogenic vibrios from shellfish. A recent 2014 study by Brett Froelich and Rachel Noble [Applied & Environmental Microbiology 80(24):7454-7459] reviews many of the studies on vibrio depuration. They show that the numerous studies of the depuration of vibrios have been highly variable in their results, but that relay of shellfish to higher salinity waters and long term depuration (>72 hours) in high salinity (> 30 ppt) seawater has the best results. However, these authors point out that simple depuration or a simple cleaning out of the pathogenic bacteria by depuration is a rather simplistic view of the complex *microbial ecology* of vibrios. They explain that the variability in the uptake and depuration rates of pathogenic vibrios by shellfish is governed by the community of existing bacteria that are normally associated with the shellfish. All shellfish carry along with them a wide variety of surface bacteria that function to live on the tissues of the shellfish, perhaps perform a health maintenance function and tend to exclude the colonization of pathogenic vibrios by virtue of their occupation of space on the surfaces of the oyster. If there is an environmental stressor such as abnormally high temperature or pollution,

the normal bacterial community on the surfaces of the shellfish is disrupted and space is opened up for invasion by the pathogenic vibrios such as strains of *Vibrio vulnificus* or *V. parahaemolyticus* that may be very persistent in depuration. These vibrios appear to be most sensitive to salinity and their activity slows greatly at low temperatures.

These findings suggest that probiotic bacteria isolated from the surface of healthy shellfish may be a means for controlling pathogenic vibrios and other pathogenic bacteria. Using this approach in 2011, Diane Kapareiko and co-workers at the US-NMFS Shellfish Laboratory at Milford Connecticut [Journal of Shellfish Research 30(3):617-625] have used a non-pathogenic strain of vibrio (OY15) that they isolated from healthy oysters to demonstrate that it can protect oyster larvae from a known pathogenic vibrio strain (B183). Likewise in 2013, Murni Karim and co-workers at the University of Rhode Island [Journal of Shellfish Research 32(2):401-408] found two non-vibrio strains isolated from healthy oysters *Phaeobacter* sp. (S4) and *Bacillus pumilus* (RI06-95) that can protect oyster larvae from infection by *Vibrio tubiashii*, a pathogenic vibrio responsible for larval losses in hatcheries. These bacteria also protected oyster larvae from infection by *Roseovarius crassostreae*, the pathogenic bacteria causing Roseovarius Oyster Disease (ROD), formerly known as Juvenile Oyster Disease (JOD). This area of research, demonstrating the role of normal bacterial communities on the surface of oysters and other shellfish, is paving the way for the development of probiotic supplements that may be useful for control of vibrio and other oyster and shellfish diseases in the hatchery. Widespread availability of shellfish probiotics may also hold promise as additives for depuration in control of the pathogenic strains of vibrios that may be problematic

for shellfish consumers. However, much more work is needed in this area.

In the mean time, the Interstate Shellfish Sanitation Conference (ISSC) and Food and Drug Administration (FDA) in the United States, and their counterpart agencies worldwide, are looking seriously at vibrios as a threat to the shellfish-consuming public and the potential economic threats to the shellfish industry if consumer confidence in the safety of shellfish is eroded. An effort is underway to assure that regulations in the various states are adequate to protect public health, and some of the debate is vigorous. It is incumbent upon shellfish producers to encourage their own staff and others in their industry to maintain a strict cold chain from the harvest to the consumer's plate. Best available evidence suggests that good handling practices and temperature control can check post-harvest propagation of vibrios and serve to maintain shellfish as safe and wholesome. 



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