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EMS or AHPNS is caused by a common species of bacteria

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EMS or AHPNS has been identified as a bacterial disease with a toxin component. It appears to be that a strain of *Vibrio parahaemolyticus* is the cause and the toxin is phage mediated. What does this mean, how does it affect the industry and how does it affect the individual farmer?

Consider that vibrios are in every marine environment. They perform a variety of roles and many are critical to nutrient recycling. To date more than 97 strains have been characterized with thousands of substrains. Most are harmless. A few are not. Perhaps the most widely known vibrio is that responsible for cholera. As with the rest of the taxon, only a small percentage of strains carry the genes that allow them to produce the toxin that is responsible for cholera. Many strains are known to cause disease in marine aquatic animals and shrimp have been reported as being infected with many different species. Historically, vibriosis, or disease due to vibrios, is probably the single largest cause of mortality of farmed shrimp. Many animals are weakened by viral diseases and stress and succumb to bacterial infections.

Bacteria readily exchange genetic material between themselves. The most commonly known example of this is probably that of antibiotic resistance. Contrary to popular belief resistant strains are not created. They are merely selected for. Genes that encode for a variety of antibiotic resistant mechanisms exist in populations already and they are shuffled between different species and strains breeding resistance. Many toxins are transmitted in a similar fashion.

Bacteria have viruses just like all other living things do. These bacterial viruses, commonly known as bacteriophages, are almost everywhere. They are a crucial component of ecological control mechanisms. Their numbers influence microbial ecology and help to ensure that no single species of bacteria dominates. They also provide a mechanism for gene transfer and a number of toxins are found associated with these viruses. When these viruses incorporate genes into the bacterial DNA they can result in the production of many different types of toxins. The toxin that is responsible for the observed pathology is not as yet characterized.

V. parahaemolyticus is the number one cause of seafood poisoning in the US from wild (fished not farmed) seafood. It is a naturally occurring bacterial species and shrimp and fish that are caught in the wild often carry it as a part of their normal bacterial flora. It causes them no harm but when seafood is improperly stored and/or processed bacterial loads can increase resulting in the presence of toxins

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that can cause the typical gastroenteritis that one see's with food poisoning. This toxin is a specific type of toxin that acts on mammalian physiologies. It is not likely that a toxin that affects shrimp will affect humans.

Where did it come from? No one really knows this although there are reports of disease outbreaks due to *V. parahaemolyticus* in many countries over the last several decades; none report a pathology similar to that reported for EMS or AHPNS. The disease was first reported in China several years ago and has subsequently spread. If in fact a bacterial virus is the cause (in the sense that it encodes for the toxin) it can readily be spread by movement through aquatic ecosystems via natural mechanisms.

There are some very interesting observations that suggest that this may not be the whole story. The first is that there are anecdotes that co-culturing shrimp with Tilapia eliminates the problem. There are also reports that when shrimp are stocked into cages above the bottoms of the pond they do not get EMS while shrimp that forage on the pond bottoms do. We know that many different vibrio species can attach to algae and *V. parahaemolyticus* is among them. We also know that it is likely that there are going to be some *V. parahaemolyticus* strains attached to some of the PLs that are stocked. It is part of the normal flora. How the genes in the phage move will determine where the risks come from. The role of some natural food source seems to be indicated by the above observations. Perhaps they are consuming alga with the strain attached to it? Either way addressing the type of algae present in the ponds may be a part of the solution.

While there are cases of bacteria that are transmitted vertically, from broodstock to eggs to offspring in fish (notably *Renibacterium salmoninarum*) there are no cases where this has been shown in shrimp. Some viruses are suspected to be transmitted this way but most are simply on the eggs. However bacteria are much larger than viruses. External contamination of eggs by bacteria as a result of spawning is a biosecurity challenge and can readily be addressed. There is no evidence at all to support the contention (or fear) that broodstock are the source of this bacteria. It is everywhere already and responsible providers of broodstock ensure that their clients do not fail to wash and surface disinfect both eggs and nauplii.

Much is still to be learned. Where are the bacteria in the environment? What species of bacteria can carry the toxin genes? Is it only confined to *V. parahaemolyticus*? How readily is it transmitted? There are many questions that need answers to better understand how to monitor, prevent and treat the problem. The ultimate challenge to managing this disease is to manage the bacterial strains that cause it. There are a number of different ways to approach this. They start with eliminating or minimizing the loads of the potential pathogen in the environment. We can provide you with a number of tools that should be helpful in lessening the load of this vibrio in the environment, an important step in learning how to live with it.

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