

The exploitation of the viral accommodation mechanism to control viral diseases in shrimp

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Abstract:

Shrimp cultivation is threatened by viral diseases that have caused serious losses of economy and society to the shrimp farming industry worldwide. The most effective strategies to overcome this problem remain unclear. Recent studies on penaeid shrimp genome have revealed that endogenous viral elements (EVEs) of major shrimp viruses, including white spot syndrome virus (WSSV) and Infectious hypodermal and haematopoietic necrosis virus (IHHNV) occur in the shrimp genome. It was hypothesized that EVE with high sequence identity to extant viruses in shrimp and insects arise via host recognition of viral messenger RNA followed by formation of variable cDNA fragments, here called viral copy DNA or vcDNA from it by host reverse transcriptase (RT). Integration of those vcDNA fragments into the host genome is via host integrase (IN). Some of these EVE could be protective if they produced negative sense-RNA transcripts that result in degradation of viral RNA by the RNA interference (RNAi) pathway. If protective EVE occurred in germ cells, they could be passed on to the next generation and constitute heritable, adaptive immunity. It was proposed that this is the underlying natural mechanism that leads to balanced persistent infections in which one or more viruses are tolerated by shrimp and insects, sometimes for a lifetime, without signs of disease. This phenomenon of tolerance to persistent viral infections had been called viral accommodation hypothesis proposed for the first time in 2009 (VAH-2009). Until today, there are several publications from our team supported VAH-2009 including identification of protective EVEs and their cognate transcripts in the *P. monodon* domesticated broodstock, the Mendelian inheritance of EVEs in *P. monodon* and establishment of a protocol for cvcDNA (circular form of vcDNA) preparation for extracting IHHNV-cvcDNA that matched the sequence of infective IHHNV in shrimp. The extracted IHHNV-cvcDNA was shown to inhibit IHHNV replication when it was injected into *P. vannamei* challenged with IHHNV. Our interesting results supported the VAH-2009 and opens potential application of cvcDNA for shrimp vaccination and for improvement of viral tolerance in shrimp breeding stocks. In order to do that, the detailed mechanisms related to the production of cvcDNA from infecting viruses and from EVE in shrimp remain to be revealed.

Keywords:

Viral accommodation, Persistent infection, Endogenous Viral Elements (EVEs), viral copy DNA (vcDNA), RNA interference (RNAi), shrimp, viral diseases