The Macrobrachium rosenbergii nodavirus: a detailed review of structure, infectivity, host immunity, diagnosis and prevention

ABSTRACT

The Macrobrachium rosenbergii nodavirus causes white tail disease, which primarily infects giant freshwater prawns, Macrobrachium rosenbergii. The infection leads to almost 100% mortality in post-larvae, causing significant economic losses in aquaculture farms. To develop effective measures against outbreaks, a good understanding of the virus is essential. In this review, we discuss key aspects of the Macrobrachium rosenbergii nodavirus including its structure, mechanisms of transmission and infection and common strategies for detection and prevention of outbreaks. Structurally, cryogenic electron microscopy revealed that the nodavirus has a T = 3 icosahedral structure with dimeric blade-like spikes on its surface. Homology modelling comparing wild-type and enzymatically cleaved Macrobrachium rosenbergii nodavirus-like particles revealed the significance of these spikes or protruding domains for binding. In vitro and in vivo studies have identified key aspects of Macrobrachium rosenbergii nodavirus infectivity, including (i) the viral binding targets such as transglutaminase and caveolin-1, (ii) utilisation of B2-like proteins in promoting infectivity and intracellular migration, (iii) replication mechanisms and (iv) co-infection with the extra small virus. Though susceptible at a post-larvae stage, adult Macrobrachium rosenbergii is immune to Macrobrachium rosenbergii nodavirus infection. During outbreaks, polymerase chain reaction and in situ hybridisation-based detection techniques are commonly used to identify infected populations. Currently, the most useful strategies for an outbreak are physical biosecurity measures and prophylaxis such as vaccination and immunostimulants. Finally, critical gaps in research include development of immortalised shrimp cell models, elucidation of time-resolved protein changes post-infection and development of therapies to treat infections to mitigate economic losses during outbreaks.