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Shrimp Hemocyte Iridescent Virus (SHIV): An Emerging Shrimp Pathogen

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Abstract

The target of more production in aquaculture needs the intense intervention of the farming practices with extreme stocking density and other inputs, which ultimately leads to stress in the cultured system. As a result of this, many viral diseases have emerged in the shrimp aquaculture industry. Recently, the shrimp hemocyte iridescent virus (SHIV) that causes disease in shrimps and prawns has emerged as a potential threat to the shrimp aquaculture industry. The mortality rate of the disease caused by the virus is over 80%. SHIV was first reported in China in 2014, leading to significant economic losses to the shrimp farming industry. Thereafter, it has been reported in some shrimp farms in Thailand. Awareness about SHIV among stakeholders in the aquaculture sector is necessary to control and prevent further outbreaks. This article highlights the clinical signs, host species, target tissue and histopathology, geographical distribution, and preventive measures of SHIV infection.

1. Introduction

Aquaculture is one of the rapid food-producing sectors globally, which accounts for 46% of the total fish production (FAO, 2020). It is the prime source of animal protein for billions of people Worldwide, where aquaculture and capture fishery serves the livelihoods of more than 10% of the global population (Ngasotter et al., 2020). The goal of increased aquaculture production necessitates more intensive farming strategies with high stocking densities and other inputs, which in the long run causes stress in the cultured system. Subsequently, many viral diseases have emerged in the shrimp aquaculture industry, including white spot syndrome virus (WSSV), yellowhead virus (YHV), infectious myonecrosis virus (IMNV), etc. Recently, a new emerging virus, known as shrimp hemocyte iridescent virus (SHIV) belonging to the family *Iridoviridae*, has been isolated in China, which can cause high mortalities in white leg shrimp (*Penaeus vannamei*) and other shrimp species. The virus is also capable of infecting freshwater prawn (*Macrobrachium rosenbergii*).

2. Shrimp Hemocyte Iridescent Virus (SHIV)

SHIV is an emerging virus that has a huge potential threat to the

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Shrimp Hemocyte Iridescent Virus (SHIV): An Emerging Shrimp Pathogen

shrimp aquaculture industry. It is a typical icosahedral structure with a mean diameter of about 150 nm belong to the family *Iridoviridae* and within the subfamily *Betairidovirinae*. The executive committee of the International Committee on Taxonomy of Viruses (ICTV) in March 2019 approved the proposal made by Chinchar et al. (2018) that a new species of decapod iridescent virus 1 (DIV1) in a new genus *Decapodiridovirus* to include SHIV as a strain. Up to the present, DIV1 has been detected in farmed *P. vannamei*, *P. chinensis*, *P. japonicus*, *Cherax quadricarinatus*, *Procambarus clarkii*, *Macrobrachium nipponense*, and *M. rosenbergii* in China since 2014, indicating that DIV1 is a new ultimatum to the shrimp farming industry. Qiu et al. (2019) identified an iridescent virus named shrimp hemocyte iridescent virus (SHIV), which was isolated from farmed *P. vannamei* in 2014 and also detected in *P. chinensis* and *M. rosenbergii*.

3. Clinical Signs

The affected fish exhibit clinical signs such as slight loss of color on the surface, anorexia (animal stop feeding), softshell, mutilated antennae, empty stomach, and gut, whitish to the yellowish head of carapace due to pale hepatopancreas, slightly reddish body in 1/3rd of the infected shrimps in *P. vannamei* (Figure 1). Other signs include loss of swimming ability and sinking to the pond bottom, distinct white triangle area under the carapace at the base of rostrum, white head and yellow gills, atrophy (shrinkage) of hepatopancreas with fading of color (yellowing), slightly whitish muscle and mutilated antennae are remarkably observed in affected *M. rosenbergii*. The cumulative mortality of SHIV has reached over 80%.

4. Host Species

So far, SHIV is found to be prevalent in Pacific white shrimp (*P. vannamei*), Australian red claw crayfish (*C. quadricarinatus*), giant freshwater prawn (*M. rosenbergii*), Oriental river prawn (*M. nipponense*), and red swamp crayfish (*Procambarus clarkia*). Also, other known susceptible or carrier hosts include Chinese white shrimp (*P. chinensis*), Japanese tiger shrimp (*P. japonicus*), Superb freshwater shrimp (*M. superbum*), Ridgetail white prawn (*Exopalaemon carinicauda*), and water fleas (Cladocerans). This indicates a broad host range of SHIV.

5. Target Tissues and Histopathology

The target tissues that SHIV can infect include

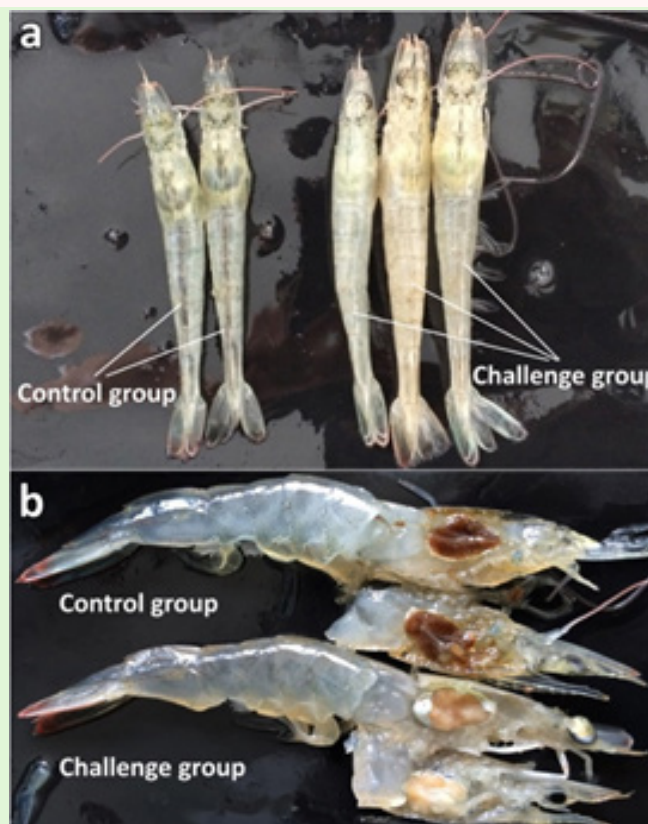


Figure 1: Clinical signs of *P. vannamei* challenged with the potential iridescent virus compared with those of the control group: (a) External appearance of the shrimp (b) Section of hepatopancreas (Qiu et al., 2017)

hematopoietic tissue, hemocytes in the following tissue/organs such as gill, hepatopancreas, pereopods, uropods, pleopods, and muscle.

Histological examination showed that dark eosinophilic inclusions bodies mixed with tiny basophilic staining and shrunken or condensed cell nuclei in the hematopoietic tissue and hemocytes in gills, hepatopancreas, and pereopods (Qiu et al., 2017).

6. Geographical Distribution and Spread of the Disease

SHIV is one of the emerging diseases of crustaceans, particularly in shrimp. It was first reported in China, and so far, it is currently distributed only in China and Vietnam. However, as per the NACA (2019) report, captured broodstock-size specimens of *P. monodon* from international waters of the Indian Ocean were found to be PCR positive for DIV1.

Shrimp Hemocyte Iridescent Virus (SHIV): An Emerging Shrimp Pathogen

7. How does SHIV Transmit?

Generally, there are two types of disease transmission, viz., horizontal and vertical transmission. The horizontal disease transmission is spread or transmitted from one animal to another by direct contact via a medium such as infected feces, fomite, or any farm input, etc. In contrast, vertical transmission is the spreading of disease from parent to offspring. In SHIV, the disease is spreading by cannibalism of diseased shrimp or through contact with infected feces indicating only horizontal transmission occurs.

8. Threat to Shrimp Farming

SHIV is considered to be a potential threat to shrimp farming due to the following reasons:

1. SHIV infects all stages of farmed shrimps, *P. vannamei*, such as post-larvae, juveniles, and adults.
2. It has a wide host range.
3. High infection rate and lethality of the virus.
4. Since the initial report of SHIV in 2014 in Zhejiang Province, a targeted surveillance study has shown that the virus is found in 10 other provinces of China, indicating the spread of the virus.
5. Another country in South East Asia, i.e., Vietnam, also recently reported it.
6. DIV1 is reported from wild-collected *P. monodon* from the Indian Ocean.

9. How to prevent Disease Outbreaks?

"An ounce of prevention is better than a pound of cure." It implies that prevention is always better than cure from the infection. Some of the following preventive measures that can be taken up to avoid the outbreak from diseases, including SHIV, are:

1. Screening of imported brood-stock like *P. vannamei*.
2. Screening of all aquaculture inputs having the potential to carry the virus, such as seed and live feed.
3. Proper biosecurity protocols at the farm levels.
4. Screening of cohabiting fauna for the potential carriers of the disease.
5. Active farm-level surveillance.

10. Conclusion

The significant demand for food due to the increasing

population necessitates higher production in food-producing sectors. Aquaculture contribution in this sector is tremendous through high stocking density intensive farming, particularly the shrimp aquaculture industry, which has potentially high-value food. As a result, new emerging diseases are being reported. Therefore, proper aquaculture practice in shrimp farms should be followed to avoid the outbreak of disease, including SHIV, that is a potentially massive threat to the shrimp aquaculture industry.

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