

## **Viral diseases of shrimp**

### **Introduction:**

Shrimp farming in the Asia-Pacific region is one of the most lucrative aquaculture sectors. Asia leads the world in cultivated shrimp production with export earnings in the order of billions of US dollars per year. The pioneers for shrimp cultivation have been Japan, India, Thailand, China, Philippines, Vietnam, Iran, Ecuador, Taiwan and some other countries in the Southeast of Asia and South America and so Australia. Thailand alone has been the world's leading producer since 1992 with its export earnings alone reaching more than 1 billion US dollars per year. Iran export shrimp. It is about 6000 metric ton annually and its value is about 30 M\$ per year. Iran not only cultivated shrimp but also is cultivating other aquatic animals such as Sturgeon, Rainbow trout, Carp and Tilapia.

Viruses are the most common biological agents in the marine environment and it is known that they infect Fish, Shrimp and other aquatic animals. Marine crustaceans can be simultaneously infected by more than one type of virus.

- 1) White-spot syndrome virus (WSSV or PmNOBII a mistake name which called for WSSV).
- 2) Monodon baculovirus (MBV).
- 3) Yellow-head virus (YHV).
- 4) Hepatopancreatic parvovirus (HPV).
- 5) Related Australian lymphoid organ virus (LOV).
- 6) Gill associated virus (GAV).
- 7) Infectious hypodermal and hematopoietic necrosis virus (IHHNV).
- 8) Taura syndrome virus (TSV).
- 9) Mourilyan virus (MOV).
- 10) Laem Singh virus (LSNV).
- 11) Baculovirus midgut gland necrosis virus (BMNV).
- 12) Monodon slow growth syndrome (MSGS).
- 13) Infectious myonecrosis virus (IMNV).
- 14) Macrobrachium rosenbergii nodavirus (MrNV).
- 15) Extra small virus (XSV).

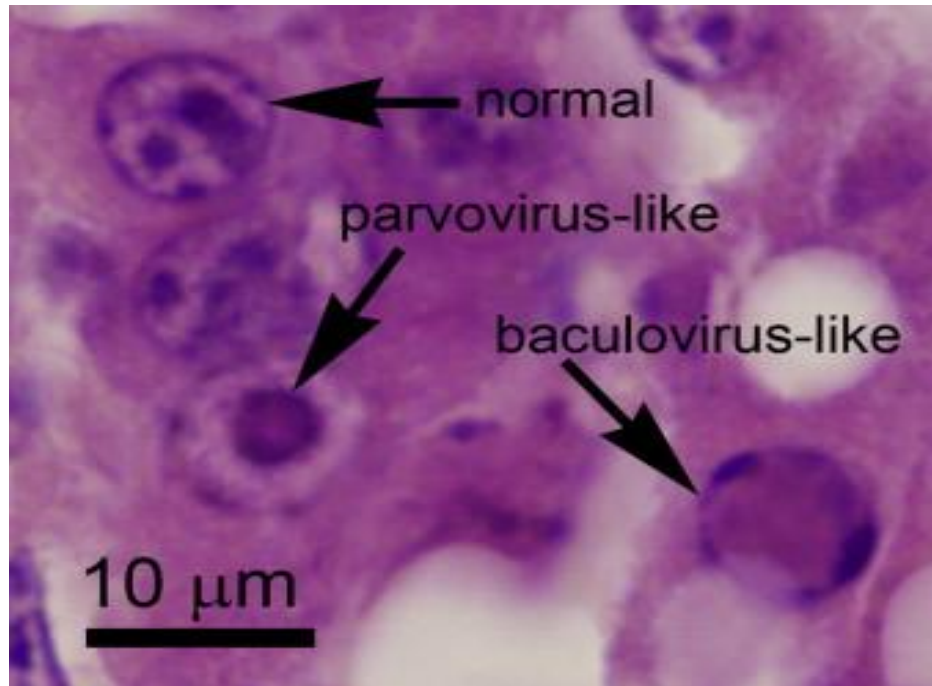
### **Pathogenic DNA viruses in shrimp**

DNA viruses which cause infection in shrimp contain: IHHNV, HPV, WSSV, MBV and BP.

### **Pathogenic RNA viruses in shrimp**

RNA viruses which are infectious for shrimp contain: YHV, GAV, LOV, TSV, IMNV, MOV, MrNV, XSV and LSNV. Several positive sense RNA (+ssRNA) viruses have been reported from shrimp. Most notably, these include yellow head complex viruses (YHV), and Taura syndrome virus (TSV).

#### **1. Monodon baculovirus (MBV)**



**Introduction:**

Even though MBV is not a severe pathogen for the black tiger prawn (*Penaeus monodon*), it should be eliminated from the farming system because it is unlikely that shrimp could carry such heavy viral infections without paying some price.

**Virion:**

MBV is a DNA-virus like white spot syndrome virus (WSSV) and hepatopancreatic parvovirus (HPV). It is a double stranded DNA (dsDNA) virus.

**Signs:**

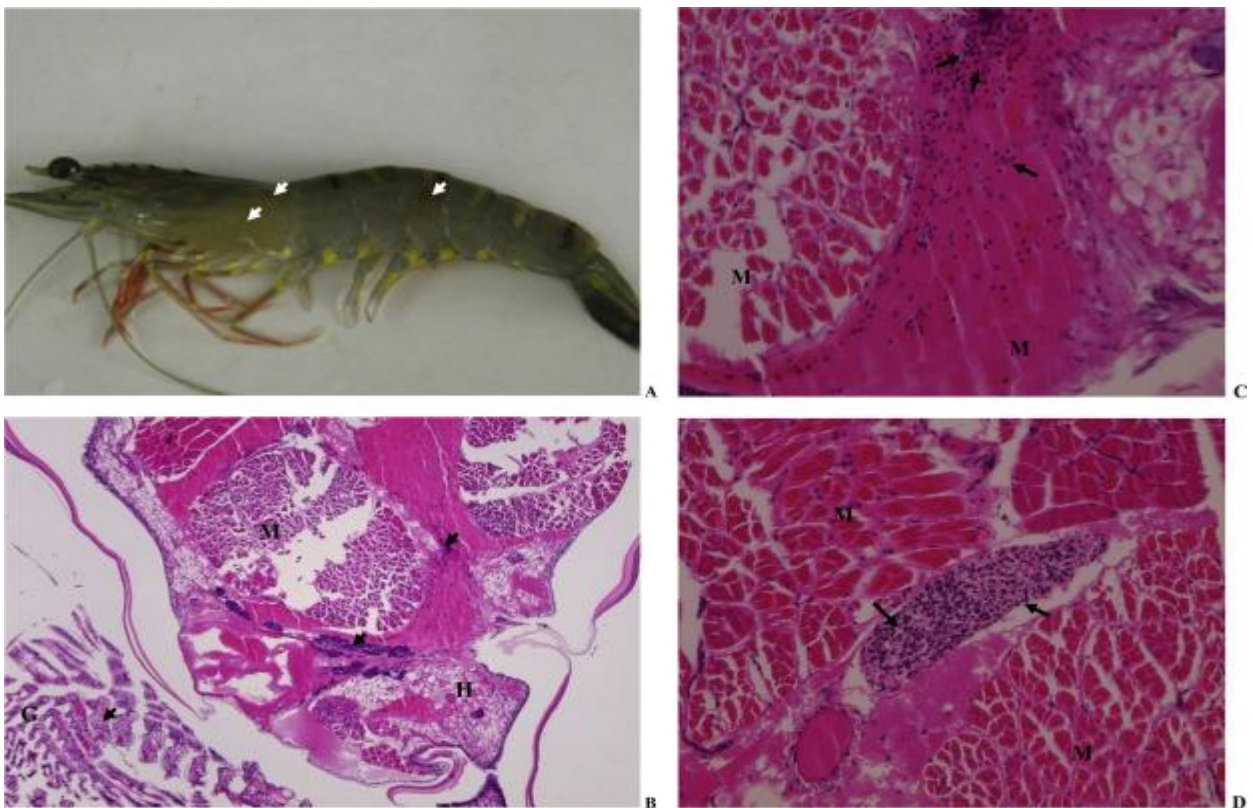
MBV did not cause shrimp mortality so long as rearing conditions were good. The infection of this virus retards growth of the shrimp which named stunted-growth and resulted in economic losses.

**Diagnostic:** The viral inclusions can be seen directly through the cuticle of early PL specimens using the light microscope. In tissue sections stained with hematoxylin and eosin (H&E). Transmission electron microscopy is a potent tool to recognition viral particles in specimens. Polymerase chain reaction (PCR) is a rapid method for viral detection. However, experience has shown that the Taiwanese primers do not work with MBV from Thailand and Australia.

## 2. Yellow-head virus (YHV)

### Introduction:

YHV was first mistakenly considered to be a baculovirus but it was soon discovered during purification and characterization that its morphology differed from that of baculoviruses. Now, it is classified as Roniviridae.



### Virion:

Rod-shaped, enveloped virion. Its genome contain positive sense single-stranded RNA (+ssRNA).

### Signs:

Gross signs of disease that included a yellowish cephalothorax and very pale overall coloration of moribund, infected shrimp.

### Diagnosis:

Histologically, YHV infections can be easily recognized by densely basophilic inclusions, particularly in H&E stained gill sections and rapidly stained whole gills, or by staining of hemolymph smears. Diagnosis is currently best by RT-PCR method rather than in situ hybridization. There is RT-PCR

recognition kit based on the work done in Thailand and Australia. The kit is not useful to detect the types of YHV found in India. In addition to nucleic acid-based tests for YHV group viruses, monoclonal antibody assays have also been developed for diagnosis by immunohistochemistry. Dot blot assay and lateral flow chromatographic assay are accessible.

### 3. White-spot syndrome virus (WSSV)

#### Introduction:

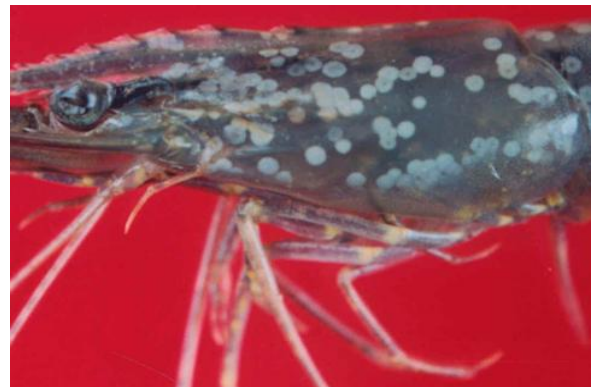
Historically, WSSV was the second viral disease to seriously disturb Thai shrimp farmers. It has been demonstrated that spawning induces WSSV replication in *Penaeus monodon*.

#### Virion:

This is a tailed, rod shaped, double stranded DNA virus with a very large circular genome in the order of 300 kbp. White spot syndrome virus belongs to the new virus family which called Nimaviridae and genus *Whispovirus*. The G+C ratio of white spot syndrome virus (WSSV) is about 41%.

#### Signs:

WSS-virus is highly pathogenic affecting various crustaceans. The infection in shrimp causes mortality up to 90–100% within 3–7 days post-infection. White spot disease (WSD) has been reported to cause severe mortality in farmed shrimp especially black tiger shrimp in many countries. Mass mortalities began to be reported with characteristic gross signs of WSSV infection.



#### Diagnosis:

Histopathology with the light and electron microscopes can indicate infection. On the basis of gross signs of disease, histopathology with the light and electron microscopes and molecular method based DNA methods used to distinguish virus. In situ DNA hybridization tests with cultivated shrimp of various species from several Asian countries that showed gross signs of white spot syndrome. PCR methods have been described for WSSV either singly. Methods for real-time PCR and isothermal DNA amplification have also been described. After development of DNA hybridization probes for WSSV in Thailand primers for PCR detection of WSSV were quickly developed. In addition to PCR

tests, immunological tests have also been described, lateral flow chromatographic detection strips are now accessible from both Japan and Thailand.

#### **Vaccine (Prevention and Control):**

Trials show a new era for shrimp vaccination although shrimp immune system isn't like vertebrates. The results of some trials indicate the possibility of vaccination of kuruma shrimp with recombinant proteins against WSSV. However, new recombinant vaccine from VP28-Protein against WSSV is under studying. There is growing evidence that invertebrates, including crustaceans, possess some form of 'immune memory' or 'priming' mechanism that can be stimulated by past exposure to an infectious agent.

#### **4. Hepatopancreatic parvovirus (HPV)**

##### **Introduction:**

HPV was first described from farmed marine shrimp in Singapore. Also, It is proposed to call this virus *P. merguensis* densovirus (PmergDNV). Hepatopancreatic parvovirus (HPV) is pathogen for cultivated and wild penaeid shrimp species including *Penaeus monodon* and *Fenneropenaeus chinensis*. Hepatopancreatic parvovirus infects the hepatopancreas in *Penaeus monodon* and is associated with slow growth that decreases profitability for shrimp farmers.

##### **Virion:**

HPV is a single-stranded DNA (ssDNA) virus that is non-enveloped icosahedral virus averaging 22–23 nm in diameter and containing linear ssDNA. As such it belongs in the family Parvoviridae in the densovirus group. Two Asian types have been characterized at the molecular level, one in *F. chinensis* from Korea and the other in *P. monodon* from Thailand. They differ in total genome length (approximately 4 and 5 kb, respectively). HPV genome consisted of 6321 nucleotides [54]. HPV belongs to the Parvoviridae family, Parvoviruses are unique among all known viruses in having single-stranded DNA genomes which are linear.

##### **Epidemiology:**

HPV may have been of Indo-Pacific origin but later spread to wild shrimp in the Americas via importation of live Asian shrimp for aquaculture. In any case, it is now considered worldwide in distribution. Horizontal and Vertical transmission of HPV have been described. It is proposed that HPV may have an unknown reservoir and carriers.

##### **Signs:**

The infection of this virus delays growth of the shrimp and resulted in economic losses. Heavy infections caused in poor growth, which decreases shrimp production and without visible inflammatory response.

##### **Diagnosis:**

Gross signs are not sufficient for HPV identification and other tests such as histological analysis or PCR testing are essential. DNA sequence analysis has revealed that there are different geographical kinds of HPV. It is recommended that different PCR primers be used for their detection. In addition to PCR, monoclonal antibodies for HPV detection have recently been produced and it is hoped that a lateral flow chromatographic test will soon be available. Positive diagnosis is based on the presence

of hepatopancreatic lesions showing basophilic inclusions within enlarged nuclei of tubule epithelial cells, and sometimes adjacent mid-gut cells. Traditional PCR, PCRELISA, real-time PCR and histopathology for detection of shrimp hepatopancreatic parvovirus (PmDENV) is applicable. Loop-mediated isothermal amplification (LAMP) combined with amplicon detection by chromatographic lateral flow dipsticks (LFD) allowed simpler detection. In situ hybridization is another method to diagnosis. A number of diagnostic methods were established for detection of this virus including histological method (H&E staining), Transmission electron microscopic (TEM), in situ hybridization, and polymerase chain reaction (PCR).