Viral Diseases of Cultured Marine Fish and Shrimp in Korea

Sang-Gyu Sohn and Myoung-Ae Park

Pathology Division, National Fisheries Research and Development Institute, Pusan 619-900 KOREA

(Received May 25, 1998)

As the marine aquaculture industry has developed, disease problems have increased and caused serious economical losses in the fish production in Korea. Viral diseases are among the major disease problems with mass mortality. Six viruses have been isolated from marine fish and shrimp. This paper reviews the following six viral diseases: viral epidermal hyperplasia (herpesvirus) in flounder, birnaviral disease in flounder and sea breams, viral nervous necrosis (nodavirus) in sevenband grouper, lymphocystis disease (iridovirus) in several marine fishes, snout ulcer disease in tiger puffer and white spot syndrome (baculovirus) in Penaeus chinensis.

Key word: viral disease, viral epidermal hyperplasia, birnaviral disease, lymphocystis, viral nervous necrosis, white spot syndrome

Aquaculture in Korea has grown rapidly following development of the artificial seed production in the 1980s. At the same time, mass mortalities have occurred frequently among cultured animals due to environmental pollution, overstocking and outbreaks of infectious diseases with losses increasing every year. Among the pathogens, virus has been one of the major causitive agents of diseases of cultured marine fishes and shrimp in Korea.

Losses in number and percentage of marine fish and shrimp due to diseases in 1997 are shown in Table 1. Viral disease is responsible for the majority of these losses.

Following the first survey of fish in Korea for viral pathogens in 1982, several viruses have been isolated from freshwater and marine fishes. This paper describes the current status of viral diseases of marine fish and shrimp in Korea.

Major viral diseases

Development of seed stock production techniques has accelerated the growth of aquaculture of economically important marine animals in Korea. However, high mortalities due to viral infections often occur during the seedstock production and growout stages. Six viral diseases have been diagnosed in cultured marine fish and shrimp in Korea, which are listed in Table 2.

Viral epidermal hyperplasia

In 1985, the first occurrence of viral epidermal hyperplasia in Japanese flounder (Paralichthys olivaceus) larvae was recorded at a private hatchery in Japan (Iida et al., 1989; Nakai et al., 1991). In Korea, epidermal hyperplasia has also been confirmed in Japanese flounder hatcheries on the eastern, western and southern coasts since 1990.

This disease occurred in fish that were 10 to 30-day-
old and reared at 18 – 20°C. Mortality usually reached 80 – 90% in a few weeks. Infected fish have darkened color and opaque dorsal, caudal and lateral fins, and their caudal fin rays curve inward.

Histological and microscopic examinations of affected fin and skin areas reveal the presence of hyperplasia, vacoule formation in the cytoplasm and necrosis of the epidermis. Electron microscopy reveals hexagonal virus particles in the nucleus of the affected epidermal cells. Virions were 100 – 140 nm in diameter typical of herpesviruses. This virus seems to belong to the Family herpesviridae as Iida et al. (1989) noted.

Indirect fluorescent antibody (IFA) test is used to detect viral epidermal hyperplasia specific virus antigens in smears or sectioned preparations of affected fins of the fish.

The best control strategy for viral epidermal hyperplasia among young fish is prevention. Eggs should be obtained from epidermal hyperplasia-free brood fishes. It was known that the lower water temperature like 15°C was more effective to reduce the damage of the infection in Japanese flounder than 20 and 25°C (Masumura et al., 1989).

**Birnaviral disease**

A birnavirus has been reported to occur in flounder larvae in Korea (Sohn et al., 1995). Since 1993, Mass mortalities have been recorded among fry in several flounder farms. In recent years, birnaviral disease has been also observed in red sea bream reared in net cage culture farms.

Fish affected by birnaviral disease show hemorrhage in the head, swelling of the spleen, accumulation of ascites and weak swimming at the water surface. Electron microscopic examination reveals unenveloped hexagonal virus particles with an average diameter of 50 – 55 nm. Serological and molecular properties of Korean birnavirus isolates were closely related to those of infectious pancreatic necrosis virus serotypes Ab and Sp (Sohn et al., 1995). Cell culture, IFA test using monoclonal antibody and PCR methods (Kang et al., 1997) have been used for birnavirus detection.

Prevention is the most important for the control of birnaviral disease. Disinfection will not inactivate the virus on the eggs. Therefore, eggs should be obtained from birnavirus-free brood stock.

**Lymphocystis disease**

Lymphocystis disease is an infection of the epidermal skin and fins that occurs in many marine fishes, such as winter flounder (Murchelano, 1976), sea bass (Miyazaki and Egusa, 1972) and yellowtail (Matsusato, 1975). Lymphocystis disease was found in net cage cultured rock fish (Sebastes schlegeli) in Korea and was first reported in 1988 (Chun, 1988).

This disease is easily recognized because an apparent pathological change occurs on the body surface. Lesions are shown as rough and warty growth on the skin and fins.

Masses of lymphocystis cells may occupy large areas or may be few in number but typically create small lesions that are usually white, gray, or pinkish white in color. Lymphocystis virus is a member of the Iridoviridae with an icosahedral-shaped virion having a diameter of 200 – 300 nm. Diagnosis of this disease is based on gross appearance of the lesions and histopathological evidence of epithelial connective tissue cell hypertrophy.

Control of lymphocystis disease in fish farms may be achieved by removal of fishes with obvious signs of the disease. It is significant that the fish population should be kept at low density for the prevention of the disease.

**Viral nervous necrosis**

Nodaviruses have been reported to cause viral nervous necrosis(VNN) in various fish such as red spotted

---

**Table 2. Viral diseases of marine fish and shrimp in Korea**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative virus</th>
<th>Host species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viral epidermal hyperplasia</td>
<td>Herpesvirus</td>
<td>Flounder</td>
</tr>
<tr>
<td>Birnaviral disease</td>
<td>Birnavirus</td>
<td>Flounder, Sea breams</td>
</tr>
<tr>
<td>Lymphocystis disease</td>
<td>Iridovirus</td>
<td>Flounder, Sea breams</td>
</tr>
<tr>
<td></td>
<td>Rock fish, Sea breams</td>
<td></td>
</tr>
<tr>
<td>Viral nervous necrosis</td>
<td>Nodavirus</td>
<td>Sevenband grouper</td>
</tr>
<tr>
<td>Snout ulcer disease</td>
<td>?</td>
<td>Tiger puffer</td>
</tr>
<tr>
<td>White spot syndrome</td>
<td>Baculovirus</td>
<td>Penaeid shrimp</td>
</tr>
</tbody>
</table>
grouper (Mori et al., 1991), striped jack (Arimoto et al., 1993), kelp grouper and tiger puffer (Nakai et al., 1994), Japanese Flounder (Nguyen et al., 1994), sevenband grouper (Fukuda et al., 1996) and sea bass (Frerichs et al., 1996).

Mass mortality of the sevenband grouper, Epinephelus septemfasciatus caused by VNN in Korea has occurred in adult as well as in larvae during the summer season and the mortality in larvae usually reached over 80% within a few weeks. Affected fish showed clinical signs of anorexia, dark coloration, spiral swimming behavior and vertebral deformity. Histopathologically, necrosis and vacuolation of the nerve cells in the brain and retina were observed (Sohn et al., 1991). Electron microscopic examination revealed unenveloped icosahedral viral particles about 30 nm in diameter in the cytoplasm of nerve cells of the brain. In addition, the presence of nodavirus in the sevenband grouper was confirmed by using PCR technique (Sohn et al., 1998).

**Snout ulcer disease**

Snout ulcer disease occurred in Korea during the high temperature periods in 1989 and 1990. Mortality was over 80% and constituted the major disease problem of cultured tiger puffer. The initial sign of infection is a darkened color of mouth that becomes necrotic and whitish. The causative virus was isolated in primary cell culture of tiger puffer, but has not yet been classified (Inouye et al., 1992).

This disease has disappeared gradually in Korea because of the decrease in tiger puffer culture.

**Viral disease of shrimp**

Most shrimp farming in Korea are semi-extensive system and are located on the western coast. Recently, the production of Penaeus chinensis is decreasing due to a new viral disease called white spot syndrome. The outbreaks of the viral disease caused serious mortality among cultured P. chinensis populations in 1993. The causative agent was a new bacilliform baculo-like virus (Takahashi et al., 1994). The most typical sign of this disease was white spots (1–2 mm in diameter) on the inside surface of the carapace. The body color of the affected shrimp became raddish or pale.

Electron microscopic examination revealed the presence of bacilliform, enveloped, nonoccluded virus in the nuclei of cells in the cuticular epidermis of the stomach and lymphoid organ. The size of the nucleocapsid was about 90 × 270 nm. The causative virus was detected by PCR assay of infected shrimp (Kim et al., 1998).

**References**


Nguyen, H. D., T. Mukuchi, K. Imura, T. Nakai, T. Nishizawa


