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SHRIMP DISEASES : SYMPTOMS, CAUSES, DIAGNOSIS, PREVENTION AND CONTROL



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SHRIMP DISEASES: SYMPTOMS, CAUSES, DIAGNOSIS, PREVENTION AND CONTROL

Shrimp farming industry has made rapid progress during the past decade. However, the industry has suffered a serious setback mainly due to disease problems. Among the diseases, white-spot disease has posed as a serious challenge to the shrimp culture operations. Cultured shrimps suffer from various diseases due to infectious and non-infectious causes. Infectious diseases are caused by viruses, bacteria, fungi, and certain parasites, while those of non-infectious etiology are caused by unhealthy environmental conditions. Diseases that have caused havoc in shrimp farming during the past 7 years in our maritime states are mainly of viral etiology. This hand-out is aimed to provide an understanding of the diseases, causative agents, and precautions to be taken for avoiding recurrence of diseases in cultured shrimp.

INFECTIOUS DISEASES

Viral Diseases

White spot disease (WSD)

Signs and symptoms

Infected shrimps show generalized signs of disease such as rapid reduction in feed consumption, and during the initial stages of infection, minute white spots of up to 2 mm diameter appear on the head (cephalothorax) and tail. Subsequently they spread all over the shell (exoskeleton). The cuticle becomes loose and the body and appendages show reddish discolouration. White spots are prominent in tiger shrimp (*Penaeus monodon*), whereas the Indian white shrimp (*P. indicus*) often turns opaque upon infection. Smaller sized shrimps (< 5 g) succumb to disease within 2-3 days and larger shrimps (10-40 g) within 5-10 days.

Causative agent

White-spot syndrome is caused by a double stranded DNA virus, called as white-spot virus (WSV) or white-spot syndrome baculovirus (WSSB) complex or systemic ectodermal and mesodermal baculovirus (SEMBV).

Diagnosis

WSD can be presumptively identified by microscopic examination of tissue impression smears stained by Geimsa's stain. These preparations reveal extensive damage and presence of viral inclusions in the cuticular epidermis, gills, lymphoid organ and gut wall. With the advent of developments in molecular biology, diagnosis of viral infections could be rapidly done employing techniques like polymerase chain reaction (PCR), gene probes, and *in situ* hybridization techniques. In the absence of these techniques, conventional

histopathological techniques will be of great help in diagnosis. The fixed tissue sections stained with haematoxylin and eosine reveal intranuclear inclusion bodies in the hypertrophied nuclei of gills, cuticular epithelial cells, connective tissue cells and lymphoid organ. However, histopathological techniques are relatively laborious and time consuming. Bioassay of filtered tissue homogenates could be also used to confirm viral etiology. WSV can be also confirmed by electron microscopic examination. The virus is of 70-150 by 275-380 nanometer (one nanometer is one millionth of a millimeter) size and rod-shaped.

Prevention and control

So far, no control measures are known. Only integrated management involving quarantine, routine screening of shrimp for viral infection and good husbandry practice could avoid the disease. Infected stock must be properly disposed by incineration or burying away from the farm sites.

Infectious Hepatopancreatic and Lymphoid Organ Necrosis (IHLN)

Signs and Symptoms

The infected shrimps exhibited light pinkish to yellowish discolouration of the cephalothorax region and were most often associated with fouling by ciliate protozoa such as *Zoothamnium*. The hepatopancreas of affected shrimp was highly decayed (necrotic) and blackened (melanised). Shrimp affected with IHLN disease often were associated with secondary bacterial infection. Bacteria such as *Vibrio alginolyticus* could be readily isolated from the haemolymph samples.

Causative agent

The primary cause of the disease is attributed to viral etiology.

Diagnosis

Presumptive diagnosis of IHLN could be achieved based on the gross clinical signs and symptoms and confirmed by histopathological examination. The hepatopancreas shows multifocal necrosis, marked by haemocytic infiltration and encapsulation resulting in melanisation. Densely stained globular basophilic bodies resembling viral inclusions could be observed in the tubular epithelium and interstitial cells of the hepatopancreas. Lymphoid organ shows marked necrosis with degeneration of stromal matrix cells. Histologically, haemocytes are normal. Gills did not exhibit any pathological signs.

Prevention and control

Although viral etiology was the primary cause of the disease, secondary bacterial infection and environmental degradation caused mass mortality of shrimp in the affected ponds. Some of the water quality parameters such as total suspended solids, chemical oxygen demand, biochemical oxygen demand and free ammonia were present above tolerable levels in the ponds during the outbreak of disease.

Hence, efforts must be made for keeping the physico-chemical conditions of pond environment within acceptable levels. Since bacterial and viral pathogens spread through external sources such as drawal of contaminated water from feeder canal, closed culture could be useful in prevention of IHLN disease.

Monodon-type baculovirus (MBV)

Signs and symptoms

Infected shrimps show generalized signs of disease such as lethargy, anorexia, poor feeding, dark colouration and reduced growth rate. MBV infected shrimps are often associated with fouling of gills and appendages by ciliates such as *Zoothamnium* spp. and *Vorticella* spp. Acute infection leads to loss of epithelial cells of tubules of hepatopancreas. Shrimps affected with MBV often acquire secondary bacterial infections and succumb to mixed infections. In case of acute MBV infection in hatcheries, mortality of larval shrimp may affect up to 70-90% of the stock.

Causative agent

MBV disease is caused by a double stranded DNA virus and is popularly called as monodon baculovirus.

Diagnosis

Diagnosis of MBV could be done by microscopic examination of simple squash preparation of hepatopancreas stained with 0.1% aqueous malachite green. Intensely stained single or multiple spherical intranuclear inclusion bodies ranging from 0.1 μm to as large as 20 μm could be observed in the cells of the hepatopancreas. Such oval-shaped occlusion bodies can be also found in fresh samples of fecal strands. Diagnosis can also be achieved by histopathological techniques by demonstration of prominent single or multiple, pinkish oval (eosinophilic) bodies in the hypertrophied nuclei of epithelial cells of hepatopancreas, in the haematoxylin and eosin (H&E) stained tissue sections. MBV could be also diagnosed rapidly by polymerase chain reaction (PCR). Digoxigenin labelled DNA probes are commercially available for diagnosis of MBV infection in fixed tissue sections by *in situ* hybridization technique.

Prevention and Control

No control measures are known. Disease may be avoided integrated management, involving quarantine and routine screening of shrimp for viral infection. Infected stock must be properly disposed by incineration or buried far away from the farms.

Hepatopancreatic parvo-like virus (HPV) disease

Signs and symptoms

Affected shrimps show generalized signs of disease such as reduced feeding, poor growth rate, body surface and gill fouling with ciliates, occasional opacity of abdominal muscles, and atrophy of

hepatopancreas.

Causative agent

HPV is caused by a small (22 - 24nm size) DNA virus.

Diagnosis

HPV can be diagnosed by histopathological demonstration of single prominent basophilic (pinkish) intranuclear inclusion bodies in the hypertrophied hepatopancreatic tubule epithelial cells by haematoxylin and eosin staining method. The host cell chromatin gets compressed, margined and displaced. HPV infection can be confirmed by transmission electron microscopic demonstration of virions of 22 - 24 nm size.

Prevention and Control

HPV infection could be avoided by quarantine and screening for pathogen. No control measures are known.

Bacterial diseases

Systemic vibriosis

Systemic vibriosis is a very common bacterial disease of cultured shrimp. Mortality due to systemic vibriosis may become significant when the culture systems are poorly managed.

Signs and Symptoms

Infected shrimps show opaque abdominal musculature, pale gill filaments, melanised (black) ventrolateral edges of the carapace, flared up gill covers (branchiostegites) popularly known as German helmets, blisters on the shell, brownish to black cuticular lesions and dorsal flexure of the abdomen. Shrimps also show reddish discolouration of the body and appendages. The haemolymph will be turbid in nature and its clotting time is delayed. The post-larval stages when affected do not consume feed and hence lack fecal strands. The tips of appendages may be necrosed and become brownish. Swarming bacteria could be observed in the body cavity (haemocoel) of moribund shrimp larvae under the microscope.

Causative agent

Systemic vibriosis can be caused by bacteria such as *Vibrio alginolyticus*, *V. parahaemolyticus*, *V. anguillarum*, *V. vulnificus*, *V. damsella*, *V. fluvialis* and *V. mimicus*.

Diagnosis

Diagnosis of vibriosis is usually based on gross clinical signs and symptoms and confirmed by isolation of bacteria by microbiological techniques. Haemolymph of affected shrimp contains numerous bacteria and upon culture, yield *Vibrio* spp. on the culture media. Bacteria could be isolated on culture media such as Zobell's marine agar or thiosulphate citrate bile salts sucrose (TCBS) agar by inoculation

of haemolymph / tissue homogenates / larval shrimp on the agar plates. Identification of the bacteria could be achieved by morphological, physiological and biochemical characterization of the isolates.



Flared up gill covers (above) and melanised (black) ventro-lateral edge of carapace (below) in tiger shrimp (*P. monodon*)

Prevention and control

Maintenance of good water quality to reduce bacterial counts in the culture system will be of immense help in reducing incidence of bacterial infection in hatcheries and culture ponds. However, methods employed to obtain quality water in the culture ponds have practical problems. Overcrowding of shrimp must be reduced. Feeding regimes must be also be strictly adhered to and overfeeding or underfeeding should be avoided.

Luminescent bacterial disease

Signs and symptoms

Eggs, larvae, post-larvae, juveniles and adults of shrimps may suffer from luminescent bacterial disease. Affected shrimp larvae become weak and opaque and exhibit greenish bioluminescence under darkness. The luminescent bacterial disease may lead to complete loss of stock in the hatcheries.

Causative agent

Luminescent bacteria such as *Vibrio harveyi* and *V. splendidus*.

Diagnosis

The disease can be diagnosed based on gross signs and symptoms. Microscopic examination of infected larval shrimp would reveal large number of swarming bacteria in the haemocoel. Bacteria could be readily isolated on common culture media, such as Zobell's marine agar or nutrient agar supplemented with glycerol.

Prevention and control

Daily exchange of 80-90% water in the hatchery and maintenance of good water quality by physical or chemical methods will help in reducing bacterial counts and incidence of bacterial infection. The hatchery facilities must be disinfected. Disinfection of the infected stock should also be done before disposal.

Fungal diseases

Larval mycosis

Larval mycosis is one of the serious diseases in shrimp hatcheries and affects the protozoa and mysis stages of most penaeid shrimps.

Signs and symptoms

Infected eggs do not hatch. The eggs and larvae are weak and appear whitish. Mortalities may reach 100% within two days. Upon infection, the fungal mycelium replaces the larval tissues and ramifies into all parts of the body and protrudes out of the body and develops into sporangia. Vegetative propagation of these fungi is through production of biflagellate zoospores, which are released into the environment. These zoospores further infect fresh shrimp larvae.

Causative agent

Larval mycosis is caused by filamentous fungi of genus *Lagenidium* spp. and other filamentous fungi, such as *Sirrolpidium* spp. and *Haliphthoros* spp. are also often associated in cases of larval mycosis.

Diagnosis

The fungus can be identified by microscopic examination of affected protozoa and mysis stages, which would reveal filamentous fungal mycelia in the body cavity of affected larvae. Fungi could be identified depending upon the morphology of discharge tube, through which the zoospores are released. The fungus can be readily isolated on simple culture media such as peptone yeast extract glucose medium or Saboraud's dextrose agar.

Prevention and control

General hatchery management practices such as use of UV sterilized and filtered seawater, adequate water exchange, etc., must be strictly adhered to. Use of anti-fungal agents during infection should be discouraged. Rearing water, equipment used in the hatchery and all the hatchery facilities must be thoroughly disinfected before restarting the hatchery operations.

Protozoan and parasitic diseases

Protozoan fouling

Protozoan fouling of shrimp is very common in the grow-out ponds and hatcheries, when the rearing conditions become poor.

Signs and symptoms

Mild infestations usually do not harm the shrimp. Heavily infested shrimps are restless, appear near the surface and periphery of the pond and show generalized signs of disease such as lethargy, lack of appetite and occasional opacity of abdominal muscles. General body and appendage fouling also affects moulting process of shrimp. Heavily affected juvenile and adult shrimp will have fuzzy mat-like appearance on them inhibiting their movement. Protozoan infestation of gills causes hypoxia (reduction of oxygen uptake) and in severe cases may lead to death of affected shrimp. Heavily infested shrimp may suffer mortality, particularly during periods when the dissolved oxygen content in the ponds is low.

Causative agent

The most common ciliate fouling is caused by *Zoothamnium* spp. Other protozoa such as *Vorticella* spp., *Epistylis* spp., *Acineta* spp. etc. are also often involved in epibiotic fouling especially in culture facilities that are poorly managed.

Diagnosis

Microscopic examination of shrimp larvae or scrapings from exoskeleton or wet mount preparations of gills of cultured shrimp reveal the identity of protozoa.

Prevention and control

Treatment with 15 to 20 ppm of formalin for 5 to 10 days depending on the extent of fouling and efficacy is usually advocated in ponds. However, primary cause of fouling must be understood before the treatment. In hatchery tanks, 25 to 250 ppm formalin treatment for 1 to 4 h daily until infestation is controlled.

Microsporidiosis (Cotton shrimp disease or milk shrimp disease or cooked shrimp or roe shrimp)

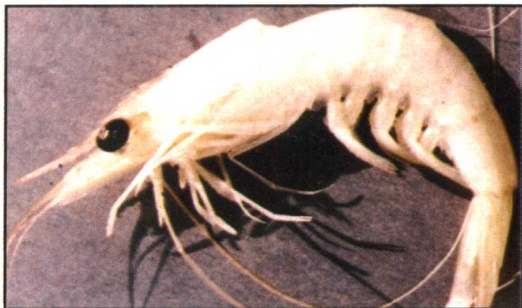
Cotton shrimp disease affects a small percentage of shrimp in the traditional shrimp farms, where management practices are poor. Microsporidiosis does not cause significant shrimp mortalities of economic significance.

Signs and symptoms

Infected shrimps appear opaque and cooked. Gradual and low levels of mortalities are observed in the affected ponds. Microsporidia invade and replace host tissues such as gills, muscles, heart, gonads and hepatopancreas, and cause necrosis of the infected tissues giving shrimp cooked appearance. Microspordian infections may often cause atrophy of gonads and render affected shrimp sterile.

Causative agent

Microsporidia such as *Thelohania* spp., *Nosema* spp., and *Pleistophora* spp.



Cotton shrimp disease in the Indian white shrimp (*P. indicus*)

Diagnosis

Microsporidial infection can be diagnosed by demonstration of microsporidian spores in the affected tissues by simple tissue impression smears under the microscope. Geimsa stained preparations also reveal the microsporidia upon microscopic examination. Microsporidia can be identified to genus level by size, shape and number of spores per sporont.

Prevention and control

Not known.

NON-INFECTIOUS DISEASES

Among the diseases of non-infectious etiology, the soft-shell syndrome of penaeid shrimp is an important disease, which causes losses to traditional extensive shrimp farms.

Soft-shell syndrome



Soft-shell syndrome in *P. indicus*: left & right affected; middle normal

The soft-shell syndrome is usually reported in the Indian white shrimp (*P. indicus*) cultured in traditional shrimp farms. Recently it has affected the tiger shrimp (*P. monodon*) also.

Signs and symptoms

The soft-shelled shrimps are weak, usually off-feed, have a loose thin exoskeleton. However, the rostrum of these shrimp is stiff as in the healthy shrimp. Wavy undulating intestine is clearly visible in the white shrimp (*P. indicus*).

Causative agent

The exact cause of soft-shell syndrome is not known. However, low saline conditions in the culture pond and the deteriorating pond bottom conditions are some of the physico-chemical factors that are reported as causative factors for the disease in the white shrimp. Those shrimps fed with the feeds having lesser protein and lipid levels are also reported to be affected by the disease. Further, the contamination of shrimp culture ponds with the discharge from the agricultural fields is suspected to be a causative factor. The soft-shell syndrome in cultured *P. monodon* was attributed to unfavourable pond condition such as high soil pH, low water phosphate and low organic matter in the soil.

Diagnosis

Diagnosis of the disease is based on gross signs of disease.

Prevention and control

Low stocking density, feeding with high quality feed and frequent water exchange are likely to reduce the recurrence of the disease.

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