Early Mortality Syndrome (EMS) of shrimp

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Focal Points at a Glance

The authors, scientists of CIBA, headed by Dr.A.G.Ponniah present to the readers an upto-date account of the various aspects of EMS, a deadly disease afflicting shrimp.

Introduction

World aquaculture production (excluding aquatic plants and non-food products) peaked in 2010, at 60 million tonnes with an estimated total value of US$119 billion. The contribution of aquaculture to global fish production increased to 40 percent in 2011 from 13 percent in 1990. It is estimated that aquaculture supplied 47.6 percent of total food fish supply for the world population in 2011. Asia has been the largest producer in the sector with 89 percent of world aquaculture production by volume , in 2010 (FAO, 2012). During the financial year 2012-13, Indian exports of marine products recorded an all-time high aggregating to 928215 tonnes valued at INR 18856.26 crore (USD 3511.67 million) (http://indianseafoodexpo.com/pdf/MPEDA%20Press%20release%20Statistics%2024.06.2013%20English.pdf, accessed on 21st Dec 2013). Frozen shrimp continued to be the major export value item accounting a share of 51.35% of exports. Shrimp production from aquaculture during the period has increased to 216,500 tonnes which was 61 percent more than the shrimp aquaculture production in 2010-2011.The estimated value of shrimp produced during the year was INR 4,073 crore (US$814.6 million), a 32% increase over the previous year (SEAI, 2012).

This growth in shrimp production in the south Asian region is attributable to introduction of Pacific white shrimp for aquaculture.

Despite this growth, the production of farmed shrimp in Asia remains lower during the current year than the previous year. Shrimp production that in Thailand, Malaysia and Vietnam is considerably reduced. Production of black tiger shrimp has also been lower as more and more farmers in Vietnam and India have switched over to Pacific white shrimp. Analysts are of the opinion that this decline in shrimp production in Southeast Asia is the result of the emergence of a new disease, "early mortality syndrome (EMS)".

This article is intended to educate shrimp farmers in India on the various aspects of this new disease including clinical signs, diagnostic tools available and preventive measures to control/eradicate the disease. This article also briefly highlights the action taken by CIBA and Government agencies in terms of disease surveillance, and contingency plan considering the devastating nature of the new disease.

History of EMS

This disease is assumed to have originated as early as 2009 in the Hainan area of China in the name of an emerging disease called 'covert mortality disease'. The Chinese named it as 'covert disease' since mortalities were occurring during very early days of culture (DOC) period, often <35-40 DOC. However, when it spread to more areas and appeared to be significant, EMS was declared to be present in China only in 2010. By 2011, the disease had spread considerably to the areas of Guangdong, Fujian and Guangxi, in ☞

addition to Hainan. The disease then appeared to infect some areas of coastal provinces in Vietnam during late 2010. This created widespread devastation in Mekong delta of Southern Vietnam and in some areas of northern Vietnam as well. EMS was reported to cause severe loss to areas in Bac Lieu, Ca Mau, Tien Gang, Ben Tre, Kien Gang, SocTrang and TraVinh in Vietnam. Though EMS was suspected to be occurring in Malaysia during late 2010, it became more prominent in 2011. The disease started in Johar and then spread to Pahang, Penang, Perak, Sabah and Sarawak. During late 2011, EMS was reported to have occurred in some farms of Thailand, located in theEastern Gulf. In 2012, EMS was also reported from farms in Trad, Chantaburi, Rayong and Chachoengsao of Thailand. Very recently in 2013, EMS has also been detected from Sinaloa and Nayarit areas of Mexico. Unless specific management and preventive measures are taken, it may be just a matter of time, before it spreads to other shrimp culturing countries in the world.

During the expert consultation in August 2012 organised by NACA and DAF, Australia, EMS was renamed as "Acute Hepatopancreatic Necrosis Syndrome (AHPNS)" based on its unique pathological effect on hepatopancreas (HP) of shrimp. Consequent to the identification of the causative agent, APHPNS was recommended to be changed as "Acute Hepatopancreatic Necrosis Disease (AHPND)". Since OIE being the highest authority regarding disease nomenclature, EMS/AHPNS is being used here.

Economic impact

EMS has caused widespread loss to shrimp farms in Southeast Asian countries. During 2011, several parts of China lost 80% culture production due to outbreak of this disease. Vietnam suffered huge loss in areas of about 20,000 hectares of farm in 2010, 11,000 hectares of farms in early 2011 and 98,000 hectares of shrimp farms during late 2011 and early 2012. Compared to 2010, Malaysia's shrimp production was reduced almost by 20,000 mt in 2011 and by 2012, this loss further increased. In Thailand, shrimp production dropped by 50% in 2012. After the outbreak in 2013, Mexico has reported more than 80% mortality in about 50% of its shrimp farms in operation and the loss was estimated to be $ 116.2 million.

Clinical sign and mortality pattern

There has been some speculation about the spread of EMS through post larvae (PL). The disease becomes apparent only when the PLs are stocked in culture ponds. The disease may appear as early as 10 days poststocking and majority of cases have been reported to appear before 45 DOC. Once infection starts in culture ponds, more than 60% mortality is recorded within 3-7 days after the initiation of clinical symptoms. Shrimp mortality may reach 100% within the next few days in the affected ponds. Main clinical signs include pale discolouration and atrophy of hepatopancreas which is the primary target organ. The HP may be shrunken and when pressed between the fingers may appear granular. Occasionally, the HP may also show black streaks. Additionally, the shrimp also show pale stomach, empty gut, reduced growth, loose shell and black discolouration. Some of the behavioural changes include lethargy, swimming sluggishly along the dikes, corkscrew swimming and reduced preening and feeding.

During the initial period, at least 3 major species, *Penaeus monodon*, *Litopenaeus vannamei* and *Penaeus chinensis*, were reported to be susceptible to this disease. However, some of the recent unpublished research claimed *Penaeus monodon* to be more resistant to this disease. In any case, the globally cultured white leg shrimp, *Litopenaeus vannamei* has been widely reported to be highly susceptible to this disease.

Causative agent

Identification of the causative agent of EMS was elusive till recently, despite efforts by leading shrimp pathologists. Farmers correlated disease outbreak to high salinity, pH and stocking density in the ponds. Due to obvious destructive effect on the HP, scientific community suspected involvement of toxins of probable origin from planktons or algae, feed and pesticides/ crusticides. Considering its rapid and high mortality pattern, the causative agent was initially thought to be a viral agent. All the corresponding outcome of experiments based on these hypotheses proved wrong. It was until the experiments of Prof.Lightner's group in Vietnam using freshly obtained affected shrimp, proved that the disease could be transmitted to healthy shrimps, and hence was infectious in nature. Following this clue, they went on to identify the causative agent of EMS as a specific strain of *Vibrio parahemolyticus*. It is now assumed that the bacteria enter through the oral route, colonise the stomach, establish quorum sensing and produce toxin, which damages the HP.

Disease diagnosis

The disease causes a typical pathology in one of the primary organs of shrimp, the HP which plays an important role in digestion. During the initial stage of the disease, some HP cells show lack of reserve granules and enlarged nuclei. During the subsequent phase of the disease, the shrimp defence cells called the haemocytes enter between the HP tubules (called as haemocytic infiltration). During the terminal phase, the HP cells round off and slough in to the lumen of the tubule. Degeneration of HP progresses from the proximal to the distal end. This acute pathology is further complicated by massive secondary bacterial infection, resulting in incapacitation of HP functions.

At present, histopathology appears to be the gold standard for EMS diagnosis. According to FAO/MARD report of June 2013 in respect of Vietnam, the diagnosis of the disease should also include the isolation and identification of the causative agent, *V. parahemolyticus* and the disease should further be reproduced by experimental infections through immersion challenge. It has been recently reported thata PCR test has been developed for diagnosis of EMS/AHPNS by Dr. Lightner's team at the University of Arizona, and has been commercialised. This PCR based diagnostic is based on a unique nucleic acid sequence of the bacterium called as contig, using metagenomics to unravel the nucleic acid sequence data of this unique strain of *V. parahemolyticus*.The kit is expected to be released during early 2014. Development of a rapid diagnosis by detecting the HP sloughing cells in the

shrimp gut is also in progress by scientists in Malaysia.

Risk to humans

It may be noted that this species of bacterium is a common inhabitant of coastal, brackish and marine waters. However, all of *V. parahemolyticus* are not pathogenic to humans. *V. parahemolyticus* strains that carry specific genes such as *tdh* and *trh* only are pathogenic to humans. The specific strain of *V. parahemolyticus* causing AHPNS in shrimp do not have these genes and hence they are regarded as not pathogenic to humans. The AHPNS specific strain does not seem to tolerate frozen temperature condition that is adopted to process the shrimp for export and transportation.

Suggested preventive and control measures

A number of trials in Thailand, Vietnam and Malaysia have been made to develop preventive and control measures to tackle EMS/AHPNS problem. Some of the following experiments appear to be promising.

1. *Stocking larger size shrimp:* It has been generally observed that shrimps are more susceptible to EMS/AHPNS during early days of stocking. Therefore, it is advocated to rear the shrimps initially in nursery ponds, grow them to larger size and then stock in ponds.

2. *Tiger shrimp as an alternative:* Recent experiments have indicated that tiger shrimp are comparatively more resistant to AHPNS. Therefore, switching over to tiger shrimp culture may help alleviate the problem.

3. *Polyculture with tilapia or culture with tilapia induced green water*: When shrimp were grown in ponds with tilapia, AHPNS problem was found to reduce considerably. Similarly, the green water that was used for shrimp culture from tilapia culture ponds, was found to be effective to control EMS/AHPNS.

4. *Shrimp culture in low saline ponds*: Anecdotal evidence suggests that EMS/AHPNS is less prevalent in ponds with salinity < 5ppt. This looks appropriate as the causative organism prefers higher salt concentration for the growth. Therefore, culturing shrimp under low salinity may help avoid EMS/AHPNS.

5. *Use of biofloc technology*: Instances of shrimp culture in biofloc induced ponds have reduced incidences of EMS/AHPNS as has been reported. Some experiments have indicated reduction in the level of EMS/AHPNS bacterial strain in the biofloc systems. Adoption of biofloc technology is likely to prevent EMS/AHPNS episodes.

6. *Use of zero water exchange / closed re-circulatory systems*: Some farmers have shown that shrimps grown in closed re-circulatory system are not affected by EMS/AHPNS. This probably avoids the contamination with the surrounding water body.

7. *Feed management:* This is particularly important during the initial stage of infection. Experiences of some farmers indicate that reducing the feed quantity during the infection stage and slowly increasing subsequently helps prevent EMS/AHPNS.

8. *Adoption of biosecurity measures:* EMS/AHPNS is caused by a specific strain of a bacterium that is common in the shrimp culture environment. Adoption of biosecurity measures may help prevent this pathogen entering the culture system. Use of reservoir ponds, avoidance of use of common water body, bird fencing etc are likely to be useful in preventing disease.

9. *Avoiding larvae/broodstock from infected area*: Though it is yet to be proved, broodstocks and larvae appear to be carrier of EMS/AHPNS bacterium. Therefore, one should avoid sourcing live animals from infected area either for hatchery or for culture practice.

10. *Testing of larvae for EMS/AHPNS*: At present there is no way to test for the specific strain of the causative agent of AHPNS. Considering its commercial availability soon, shrimp larvae should be PCR tested for EMS/AHPNS before stocking. If found positive, the larvae should be discarded/destroyed appropriately.

11. *Regular monitoring for detection and containment of AHPNS*: Regular monitoring during the early culture period, particularly ponds with mortality should be carried out. Once detected, the pond water should be disinfected within the pond by bleaching after recovering the stock. Pond water may be discharged only after deactivation of bleach by vigorous aeration overnight.

12. *Selective breeding for EMS/AHPNS resistance*: Initial trials carried out in Thailand have indicated that it is possible to develop EMS/AHPNS resistant strains, which can provide as high as 60% survivability upon challenge. Similarly, if fast growing PL could be produced by selective breeding, this will help to avoid the disease.

CIBA's research contribution on EMS

Central Institute of Brackishwater Aquaculture (CIBA), a premier research organisation under Indian Council of Agricultural Research (ICAR) has continuously been working on various aspects of disease diagnosis, prevention and control of brackishwater organisms. As a part of regular research activity, CIBA is constantly engaged in disease surveillance and in preventive measures both for the tiger shrimp and the white leg shrimp in India. Disease surveillance programme has been further invigorated by funding from the National Fisheries Development Board (NFDB). Shrimp farmers across the country have been reporting frequent disease-associated mortality from time to time with rumours of emergence of EMS/AHPNS in *L. vannamei* farming. A number of such disease outbreaks during 22-110 DOC have been investigated at CIBA. So far, samples from over 137farms have been subjected to in-depth analysis involving screening for OIE listed pathogens, bacteriology, and histopathology. Mortality recorded from many of these ponds was primarily due to WSSV infection as high load of virus in those samples were detected by 1st step PCR, and in some cases due IHHNV co-infection with WSSV. None of these samples had ☞

either clinical symptoms or pathology typical of EMS/AHPNS. Based on this work, an advisory was hoisted on the CIBA web site and several awareness meeting were carried out in different parts of Andhra Pradesh and Tamil Nadu.

Conclusion

EMA/AHPNS of shrimp has caused immense economic loss to aqua farmers in the Southeast Asian Nations since 2009. The causative agent has been identified as a specific strain of *V. parahaemolyticus*, a commonly occurring bacterium in the coastal, estuarine and marine environment. Hence, exclusion of this bacterium from aquaculture system, the basic principle of biosecurity, will be nearly impossible. The ICAR has initiated a National Surveillance Programme for Aquatic Animal Diseases (NASPAAD) with funding by National Fisheries Development Board, Hyderabad. CIBA with its collaborative partners in each of the States has embarked on targeted surveillance of EMS/AHPNS since October 2013. Shrimp farmers are advised to avoid rumours and approach research institutes nearby and provide samples for investigation. It will be in farmers' interest that they implement biosecurity protocols in their farms, adopt healthy aquaculture practices such as biofloc technology, green water technology to prevent disease problems and sustained production.

Suggested reading

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Device to save turtles: Reaction of Fishers

Though conservation activists and government officials have been trying to promote Turtle Excluder Devices (TED) to protect the endangered sea turtles, the fishing community is opposing the move fearing repercussion on their livelihood.

The coast line between Visakha and Bheemili is a popular nesting place of Olive Ridley turtles which visit every year between November and February. Every year innumerable dead turtles are washed ashore for unknown reasons.

As a preventive method, conservation activists and officials of fisheries department had come up with a multi-pronged mechanism to prevent such occurrences. Despite being offered financial assistance for purchasing these devices the fisherfolk are reluctant to use them.

Experts say that larger sea turtles, primarily large loggerheads and leather-backs are too large to escape the devices installed in most devices. These turtles caught in the net would perish it was stated.

A U.S. legislation introduced in 2003 attempted to address this issue by increasing the size of the escape chutes in the devices. But, in India, this kind of effort has to be initiated.

The nets being used by fishermen cause harm to this endangered species, fisheries officials are stated to be of the view.

Tamil Nadu: Pamban fishermen launch strike

About 3,000 country boat fishermen at Pamban launched a strike from 31 Dec 2013 protesting the arrest of 18 Pamban fishermen by Sri Lankan Navy, and demanding their immediate release, even as the magistrate court in Kayts remanded them in judicial custody till January 10, 2014.

The fishermen, who used to fish in the south sea and north sea off Pamban and moved to Sangumal, Kunthukal and Therkuvadi coasts in the island during January to March due to gusty winds in Pamban, struck work after hoisting black flags in 300 and odd boats.

It was stated that they had launched the indefinite strike to make the Central and State governments to act fast and secure the release of the fishermen at the earliest.

It is stated that after arresting the Pamban fishermen, it was stated that the Lankan navy chased away the Rameswaram fishermen, who had ventured into the sea for fishing, after damaging their boats and nets. Fearing the Lankan navy, fishermen went to the sea in only 300 trawlers, he said. The Fisheries department however, received no complaint in this regard, sources said.