A review on strategic programs to control shrimp white spot disease

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Abstract

Many programs is performed in order to aim of improving growth traits, survival, or resistance to diseases, in shrimp aquaculture. . One of the factors that reduce production in the aquaculture industry is the spread of acute diseases, especially viral diseases including a viral syndrome in the shrimps of the Penaeidea family which is usually called "white spot disease",. In this review, strategic programs to control shrimp white spot disease which can be important for increase the production including the Identifying the genetic structure of the progenitors used in reproduction, Interspecies transfer of desired genes from wild relatives to domesticated species, Use of probiotics and good quality water and also Hazard analysis critical control point (HACCP) approach in WSSV was discussed. Also identify the critical control points including control the entry, water treatment, phyco lab and finally some factors affecting the health of shrimp larvae and possible control measures has been investigated and discussed.

Keywords: Disease, WSSV, shrimp, HACCP

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Introduction

The improvement of economic efficiency in aquaculture systems is deeply dependent on breeding programs and targeted mating between breeders. For this reason, nowadays, most large breeding centers, especially shrimp, use these programs with the aim of improving growth traits, survival, or resistance to diseases, including the important shrimp white spot disease. However, there is always a risk that in the long term, the lack of proper identification and poor management of the broodstock will increase the inbreeding coefficient in the parent populations in breeding workshops. The increase in the inbreeding coefficient causes a decrease in genetic diversity, which in turn reduces the ability to respond to selection in future generations and ultimately leads to a decrease in growth, survival, and reproductive characteristics, and as a result, resistance to white spot disease. One of the factors that reduce production in the aquaculture industry is the spread of acute diseases, especially viral diseases. Since 1992, a viral syndrome in the shrimps of the Penaeidea family, which is usually called "white spot disease", has brought other shrimp diseases under its influence. White spot syndrome virus (WSSV) is by far the most devastating pathogen of farmed shrimp. It infects all cultured *penaeids* and has been responsible for much of the economic impact of disease on production globally. White spot disease (WSD) was first reported in June 1992 in cultured kuruma shrimp (*Penaeus japonicus* Bate, 1888) in the Fujian Province of China and in nearby Taiwan (Jiang, 2001). This disease caused the loss of a large number of shrimps worth thousands of dollars in farms in many countries such as: China, Japan, India, Thailand, Indonesia, Sri Lanka, Bangladesh and Malaysia, and recently in Iran (Afsharnasab, 2007). Shrimps infected with this virus, plaques leave a white color in the shrimp carapace and for the same reason, and the disease is called white spot due to calcium deposition and lack of absorption. The symptoms of this disease can be easily seen in young and adult shrimps. The white spots first appeared on the carapace of the shrimp and the 5-6 segments of the body, and in the advanced stage, the whole body is covered with white spots with a thickness of 5.5 to several millimeters. The shrimp skin or cuticle is easily separated from the copper layer. The hepatopancreas changes its shape in a yellowish-white, large and brittle form. Consider to high fertility in Shrimps for selective mating programs, there is a need for a small number of breeders in the parental line, which increases the probability of the genetic affinity of the parents selected from the large population of pre-breeders. Therefore, knowing the genetic reserves of shrimp producers can help increase production (Fig. 1).

Figure 1: The symptoms of WSSV disease in young and adult shrimps. The white spots first appeared on the carapace and the 5-6 segments of the body.

Points and objectives

The following points and objectives can be mentioned in this subject who should be considered in the strategic document:

- Identifying the genetic structure of the progenitors used in reproduction in order to reduce the level of inbreeding and create different lines from the progenitors and their coding
- Creation of a DNA bank of imported breeds in order to identify and coding the breeds Quality control of used products
- Research and monitoring of white spot disease in the target areas and breeding workshops seasonally and monthly during the shrimp breeding season.
- Printing and publishing catalogs and information necessary for the protection, evaluation and exploitation of genetic resources
- Conducting basic genetic research in order to use them in breeding.
- Identifying, obtaining and exploiting valuable genes with the ability to create resistance against white spot disease and creating different lines of breeders containing the best genetic reserve.
- Interspecies transfer of desired genes from wild relatives to domesticated species in breeding with the aim of creating resistance against white spot disease.
- Creation and maintenance of necessary databases for the protection and exploitation of reproductive genetic resources
- Holding annual international training workshops and getting to know the owners of shrimp farms in order to investigate new ways of working for the optimal use of the producers and exchange new information and ideas against white spot disease.

Use of probiotics and good quality water

The use of probiotics can be seriously considered in the strategic document against white spot disease, because increasing the number of beneficial bacteria in the pool among other existing bacteria can inhibit or reduce other pathogenic microorganisms (Peraza-Gómez *et al.*, 2009)

Outbreak of WSSV disease

The first outbreak of this disease was reported in China and Japan (1993) and destroyed 80% of farmed shrimps, but this disease is also epidemic in Asia. In 2014, it was also reported from Bushehr Province (Iran) and caused heavy casualties in this region. This disease is seen in all shrimps of the Panaidea family at the young and mature stages. No successful treatment has been reported so far to overcome white spot disease (Afsharnasab, 2014). Therefore, efforts should be made to minimize the casualties of this disease as much as possible. The use of probiotics can be useful, because increasing the number of beneficial bacteria in the pool among other existing bacteria can inhibit or reduce other pathogenic microorganisms (Lightner, 2014*)*. It should be noted that this issue cannot have magical effects and can be used for all diseases. Also, water quality factors such as DO, pH, salinity, alkalinity, ammonium and turbidity should be maintained at optimal levels (Peng *et al*., 1998). Aquatic creatures including crabs, copepods, wild shrimps and other crustaceans are carriers of white spot virus. Preventing the use of trash fish such as crabs, shrimps, oysters can either carry the virus or be infected by this virus. Therefore, feeding breeding shrimps with them can be dangerous (Hossain, 2015).

Pathogenicity, isolation and identification

White spot disease virus has been seen as a pathogen not only in shrimp of the Penaeidea family, but also in a wide range of crustaceans, including crustaceans (Flegel, 2006). A research was carried out from the samples taken from coastal crabs and oysters as well as wild edible shrimps leading to the shrimp breeding sites in Tiab region, Sayeh Khosh and Bandar Maqam (Iran) using molecular analysis (PCR method). Elnifro *et al.* (2000), suggested that due to the importance of the disease, it is better to use two-step PCR or NESTED-PCR instead of one-step PCR to detect white spot disease because it is a thousand times more sensitive. And the number of copies removed is also 10-50 times higher than one-step PCR. Lee *et al*. (1997), due to the importance of Nested-PCR, were able to produce a special kit for the diagnosis of white spot disease, which is now commercially available. In this research, 89 samples were tested and 77 samples were positive for the disease, of which 44 samples were positive with one-step PCR and 33 samples were positive with two-step PCR. However, although this disease is found in natural habitats and estuaries leading to shrimp farms, its effects on wild shrimps and other crustaceans, including wild crabs, are unclear (FAO, 2022). This disease has also been seen in wild environments and multi-purpose shrimp and crab breeding sites in the state of Texas, USA. Although the disease has been reported to have been eradicated, it still occurs in wild sources of crustaceans in the southeastern Atlantic .In the research conducted by Wongteerasupaya *et al.* (1996) on the carriers of this virus in wild crabs *Sesarma* sp., *Scylla serrata and Pugilator Uca*, which are usually used in shrimp farming areas, it was found that the above species have the necessary preparation to be infected with this virus and it was observed in the mentioned species without visible signs of disease and mortality. Gunasekaran *et al.* (2018) also tested 283 samples collected from wild crabs from breeding ponds to prove the presence of WSSV and the prevalence of viral infection was 32.5% of crabs (Yan *et al.,* 2004). This investigation and the mortality of crabs show the possibility of being infected with the white spot syndrome virus, which proves the need to prevention the entry of wild crabs through the water entering farms.

Hazard analysis critical control point (HACCP) approach in WSSV

Table 1 show some factors affecting the health of shrimp larvae and possible control measures Maximum biosecurity in shrimp production facilities is achieved through isolation of production steps (Walker *et al*. 2009).

Table 1: Some factors affecting the health of shrimp larvae and possible control measures.

Factor	Effects	Control measures	Standard
Excessive Stocking Density	Stress Cannibalism Poor water quality	Reduce stocking density	100 to 250 nauplii/litre
Poor Water Quality· Sea water(A)·Tank water (B)	Mortalities Late moulting Deformities	Improve water quality by filtration, chlorination and/or sterilization (A) Increase water exchange (B)	Filter<5mm Activatedcarbon Chlorination (10 ppm) followed by neutralization Ozone and UV 20-100% water exchange per day
Long Stocking Period	Increased infection rates of laterstocked larvae	Limit number of days in stocking hatchery	3-4 days per unit
Poor Feeding (Quality and/or Frequency)	Cannibalism Malnutrition Epibiont fouling Poor water quality	Appropriate feeding programme, Frequent checks on feed consumption and water quality	Feed every 2 to 4 hours to satiation with high quality feeds
Quality and/or Quantityof Algae	Mortality in zoeal stages Fouling of larvae	Routine counts and quality checks	*Chaetoceros* 80 000 to 130 000 cells/mL
Artemia Nauplii	Source of bacteria leading to mortality	Disinfection of *Artemia* nauplii	hypochlorite at 20 ppm active ingredient

Appropriate design of facilities with a high degree of differentiation can reduce the risk of transmission of pathogenic agents. Critical control points (CCP) identified for shrimp production stages include shrimp (brood), feed and water. Other potential hazards affected by the implementation of SOPs and HACCP include disease transmission vectors (humans and other animal vectors), facilities and equipment.

For different areas including quarantine and Artemia production etc., it is necessary to identify critical control points

Control the entry: control the entry for operational workers, office staff, vehicles, and other vectors of disease transmission to prevent transmission of infections from other breeding centers and the surrounding environment. Restricting entry to the hatchery in general and each area in particular to authorized persons: All employees and administrative staff who enter the production areas must follow the SOP (Hatchery's Standard Operating Procedures) procedures.

Water treatment: all water used in production units must be properly treated to eliminate pathogens and their hosts (chlorine, ozone, filter, etc.). Quarantine of incoming food, inspection and disinfection of fresh feed, cleaning tanks and air transmission lines, and disinfection of equipment.

Hatchery: Perform regular drying cycles. Cleaning and disinfection of buildings, tanks, filters, water lines and equipment. Quality control and disinfection of fresh feed; Separation of working materials for each room and each tank.

Phyco lab: Limited entry of employees to laboratories and reservoirs for preparing algae, disinfecting of water and air equipment. Hygiene and quality control of algae and chemicals used.

Artemia: cyst disinfection, *Artemia* nauplii disinfection, cleaning and hygiene the tank and equipments

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