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Editorial

Emerging Infectious Diseases Affecting Farmed Shrimp in Mexico

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Editorial

Shrimp aquaculture probably evolved from ancient practices done by people in Asia and America who used to enclose shrimp and other marine species in estuaries and coastal lagoons to obtain a valuable food source [1]. At present, shrimp aquaculture probably is the newest animal production activity, which started as a scientific-based animal production technique after Dr. Motosaku Hudinaga in Japan (1933) achieved the spawning of kuruma shrimp larvae, completing its larval cycle under controlled conditions [2,3].

From that breakthrough, commercial shrimp aquaculture originated in the 1960s when the first shrimp farms appeared in Asian countries such as Japan, Taiwan, China, The Philippines and Indonesia. Early in the 1970s, shrimp farming spread to American countries such as Ecuador, Honduras Panama and Costa Rica [4]. Later, other countries in Asia, America, Australia and various countries in Africa (Egypt, Eritrea, Tanzania, Seychelles, Mozambique, Madagascar) started shrimp farming operations [5,6].

In the beginning, several shrimp species were cultured in different countries, being the most common species the black tiger shrimp *Penaeus monodon*, banana shrimp *Fenneropenaeus merguiensis*, Chinese white shrimp *F. chinensis*, kuruma shrimp *Marsupenaeus japonicus*, Pacific blue shrimp *Litopenaeus stylirostris* and the Pacific white shrimp *Litopenaeus vannamei* [7]. Later, because of their traits such as size, ease to breed and culture, and fast growth rate, the farmed shrimp industry had as main species the black tiger shrimp and the Pacific white shrimp. When *L. vannamei* was introduced into several Asian countries (China, Korea, Thailand, etc.) it became the main farmed species worldwide, leaving the species *Penaeus monodon* as the second main farmed species around the year 2004 [7,8].

Almost since the beginning of shrimp farming, different infectious diseases have affected the development of the activity worldwide. Several types of infectious diseases and etiological agents have appeared in various countries at different times. Fungal, bacterial and viral diseases have been the most damaging to larval cultures and grow-out operations [9,10].

In Mexico, bacterial viral and diseases have caused production losses in shrimp farms. Bacterial diseases include vibriosis caused by different *Vibrio* species, a rickettsia-like bacteria cause necrotizing hepatopancreatitis (NHP-B), filamentous bacteria contribute to surface and gill fouling of shrimp as well as chitin-degrading bacteria provoke cuticle necrosis. Bacterial pathogens causing this injury include *Vibrio* sp., *Aeromonas* sp., *Spirillum* sp. and *Flavobacterium* sp. In hatcheries, a bacterial disease probably caused by *Vibrio harveyi* induced high mortalities to larval shrimp in zoea II stage. This disease caused detachment of the epithelial lining of tubules in hepatopancreas giving the appearance of "balls" inside the lumen of tubules and causing massive mortalities to larvae at this stage. Therefore, such a disease was called "bolitas" syndrome.

Recently (2009) a novel disease caused by distinctive *Vibrio parahaemolyticus* isolates appeared in China and rapidly spread to other countries in the region such as Thailand and Vietnam. The disease causes massive mortalities early after postlarvae stocking into grow-out ponds (30 - 60 d). Hence, the name of "Early Mortality Syndrome" (EMS) was given to the disease [11]. Until 2013, the disease was only reported in certain Asian countries, but that year, unusual mortalities occurred in shrimp farms located in northwest Mexico. At first, it was thought that mortalities were caused by WSSV or even other pathogens such as NHP-B. Diagnosis methods (PCR) were used to screen for the presence of these agents but all results came back negative. Later, researchers in Mexico found out that the disease was caused by a *Vibrio parahaemolyticus* isolate [12]. This isolate contains a plasmid encoding for a binary toxin related to the entomopathogenic bacteria *Photorhabdus luminiscens* [13]. This binary toxin is similar to the Cry toxin of *Bacillus thuringiensis*. PCR assays have been developed in Thailand and USA to detect the pathogen. The sequence of the plasmid containing the toxins has been published and it can be used to design other PCR primers and molecular-based diagnostic tools [14,15].

As an emerging disease, EMS is an interesting research subject for shrimp pathologists. Current research interests can focus on the development of fast, accurate diagnosis methods based on PCR and immunoassays to detect the toxin genes and toxic proteins in shrimp tissues. Also, interest exists to evaluate the neutralizing effect of such antibodies against the toxins, as well as the development and evaluation of products/ methods to control the disease.

Viral diseases have caused the most serious losses to farmed shrimp worldwide [16]. The first viral pathogen recorded for shrimp was Baculovirus penaei in 1974, off the Gulf of Mexico. The host species was the pink shrimp *Farfantepenaeus duorarum* [17]. Since that first record, many other viral pathogens have been reported affecting most farmed shrimp species [9,18]. Some of the major viral pathogens that have caused high mortalities include Infectious Hypodermal and Hematopoietic Necrosis Virus (IHHNV or *Penstyldensovirus*), Taura Syndrome Virus (TSV), Yellow-Head Virus (YHV) and White Spot Syndrome Virus (WSSV) [10].

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In Mexico, three of these viral diseases have been reported (IHHNV, TSV and WSSV). IHHNV probably was the first viral pathogen reported in farmed shrimp in Mexico in the 1980s and it continues to be present at high prevalence throughout northwestern Mexico [19]. Back in the 1980s, the main cultured species was the Pacific blue shrimp *L. stylirostris*. This species was seriously affected by IHHNV since it caused massive mortalities. In contrast the lesser cultured species *L. vannamei* appeared to be less affected by the IHHNV infection. In *L. vannamei*, IHHNV infection caused no mortalities, but it produced deformities in rostrum, antennae and stunted growth in the infected animals [20]. Because of the different outcomes of IHHNV infection between these species, farmers decided to change the blue shrimp for the Pacific white shrimp as the most farmed species in Mexico.

In 1995-1996 TSV was first reported in Mexico [21,22]. Soon it became a major pathogen affecting shrimp farms. TSV caused massive mortalities (60-80%) in farmed shrimp in northwest Mexico and soon after it spread to wild stocks. In contrast, the blue shrimp appeared to be less susceptible to TSV infection [21]. Once again, because of the huge damages that TSV caused to the white shrimp, farmers decided to change the white shrimp for the blue shrimp as the main cultured species. Even a SPR strain of blue shrimp was used in many farms in northwest Mexico to curb the impact of TSV with some success.

Soon after, a new viral pathogen appeared in Mexico: WSSV [23]. This viral pathogen swept all shrimp cultures at the moment, regardless of the species farmed. The presence of WSSV reduced the prevalence of TSV in Mexico and as it affected equally blue and white shrimp, once again farmers decided to switch the blue for the white shrimp. Due to the heavy losses that WSSV has caused to shrimp farming worldwide, our current research interests in this topic are focused on the alleged role of a previous IHHNV infection in shrimp to reduce the impact of WSSV infection. This has been reported in a few studies [24-26], but more research is needed to confirm its efficacy. Therefore an interaction between two viral pathogens in order to exploit the abundance of one to reduce the lethality of the other is another research interest. Also, the application of biotechnological tools such as RNAi to inhibit viral infections [27], particularly WSSV [28], is another research interest that is being pursued at present in order to improve farmed shrimp production.

References

1. Pillay TVR, Kutty MN. Aquaculture. Principles and practices. 2nd Edn. Oxford, U.K.: Blackwell Publishing Co. 2005.

2. Bardach JE, Ryther JH, Mclarney WO. Acuacultura. Crianza y cultivo de organismos marinos y de agua dulce. Mexico, D.F. AGT, Editor. 1986.

3. Treece GD, Fox JM. Design, operation and training manual for an intensive shrimp culture hatchery (with emphasis on *Penaeus monodon* and *Penaeusvannamei*). Texas USA: Texas A&M Sea Grant College Program. 1993.

4. FAO Fisheries Department. State of world aquaculture 2006. FAO Fisheries Technical Paper No 500. Rome. 2006; 134.

5. Sadek S, Rafael R, Shakouri M, Rafomanana G, Ribeiro FL, Clay J. Shrimp Aquaculture in Africa and the Middle East: The Current Reality and Trends for the Future: Food and Agriculture Organization of the United Nations (FAO), the World Bank Group, World Wildlife Fund (WWF), and the Network of Aquaculture Centres in Asia-Pacific (NACA). 2002.

6. Chamberlain G. History of shrimp farming. Global Aquaculture Advocate. USA: Global Aquaculture Alliance. 2011; 29-31.

7. FAO. The state of world fisheries and aquaculture 2012. Rome: Food and Agriculture Organization. 2012; 209.

8. Escobedo-Bonilla CM. Biology, morphology and antiviral defense of penaeid shrimp (Crustacea: Decapoda). In: Delaney CA, editor. In: Shrimp: evolutionary history, ecological significance and effects on dietary consumption. New York: Nova Science Publishers Inc. 2014; 56.

9. Lightner DV. Virus diseases of farmed shrimp in the Western Hemisphere (the Americas): a review. J Invertebr Pathol. 2011; 106: 110-130.

10. Escobedo-Bonilla CM. Application of RNA Interference (RNAi) against viral infections in shrimp: a review. Journal of antivirals and antiretrovirals. 2013; 5: 1-12.

11. Tran L, Nunan L, Redman RM, Mohney LL, Pantoja CR, Fitzsimmons K, et al. Determination of the infectious nature of the agent of acute hepatopancreatic necrosis syndrome affecting penaeid shrimp. Diseases of aquatic organisms. 2013; 105: 45-55.

12. Soto-Rodriguez SA, Gomez-Gil B, Lozano-Olvera R, Betancourt-Lozano M, Morales-Covarrubias MS. Field and Experimental Evidence of *Vibrio parahaemolyticus* as the Causative Agent of Acute Hepatopancreatic Necrosis Disease of Cultured Shrimp (*Litopenaeusvannamei*) in Northwestern Mexico. Applied and Environmental Microbiology. 2015; 81: 1689-1699.

13. Lai HC, Ng TH, Ando M, Lee CT, Chen IT, Chuang JC, et al. Pathogenesis of Acute Hepatopancreatic Necrosis Disease (AHPND) in shrimp. Fish Shellfish Immunol. 2015; 47: 1006-1014.

14. Nunan L, Lightner D, Pantoja C, Gomez-Jimenez S. Detection of acute hepatopancreatic necrosis disease (AHPND) in Mexico. Dis Aquat Organ. 2014; 111: 81-86.

15. Sirikharin R, Taengchaiyaphum S, Sritunyalucksana K, Thitamadee S, Flegel TW, Mavichak R, et al. A new and improved PCR method for detection of AHPND bacteria. Network of Aquaculture Centres in Asia and the Pacific, Bangkok, Thailand. 2014.

16. Walker PJ, Mohan CV. Viral disease emergence in shrimp aquaculture: origins, impact and the effectiveness of health management strategies. Reviews in Aquaculture. 2009; 1: 125-154.

17. Couch JA. An enzootic nuclear polyhedrosis virus of pink shrimp: Ultrastructure, prevalence, and enhancement. Journal of invertebrate pathology. 1974; 24: 311-331.

18. Lightner DV, Redman RM. Shrimp diseases and current diagnostic methods. Aquaculture. 1998; 164: 201-220.

19. Morales-Covarrubias MS, Nunan LM, Lightner DV, Mota-Urbina JC, Garza-Aguirre MC, Chávez-Sanchez MC. Prevalence of infectious hypodermal and hematopoietic necrosis virus (IHHNV) in wild adult blue shrimp *Penaeusstylirostris* from the northern gulf of California, Mexico. Journal of aquatic animal health. 1999; 11: 296-301.

20. Kalagayan H, Godin D, Kanna R, Hagino G, Sweeney J, Wyban J. IHHN virus as an etiological factor in Runt-Deformity Syndrome (RDS) of juvenile *Penaeusvannamei* cultured in Hawaii. Journal of the World Aquaculture Society. 1991; 22: 235-243.

21. Brock JA. Special topic review: Taura syndrome, a disease important to shrimp farms in the Americas. World Journal of Microbiology & Biotechnology. 1997; 13: 415-418.

22. Zarain-Herzberg M, Ascencio-Valle F. Taura syndrome in Mexico: Follow-up study in shrimp farms of Sinaloa. Aquaculture. 2001; 193: 1-9.

23. Galaviz-Silva L, Molina-Garza ZJ, Alcocer-Gonzalez JM, Rosales-Encinas JL, Ibarra-Gamez C. White spot syndrome virus genetic variants detected in Mexico by a new multiplex PCR method. Aquaculture. 2004; 242: 53-68.

24. Tang KFJ, Durand SV, White BL, Redman RM, Mohney LL, Lightner DV. Induced resistance to white spot syndrome virus infection in *Penaeusstylirostris* through pre-infection with infectious hypodermal and hematopoietic necrosis virus--a preliminary study. Aquaculture. 2003; 216: 19-29.

25. Bonnichon V, Lightner DV, Bonami JR. Viral interference between infectious hypodermal and hematopoietic necrosis virus and white spot syndrome virus in *Litopenaeusvannamei*. Diseases of aquatic organisms. 2006; 72: 179-184.

26. Melena J, Bayot B, Betancourt I, Amano Y, Panchana F, Alday-Sanz V, et al. Pre-exposure to infectious hypodermal and haematopoietic necrosis virus or to inactivated white spot syndrome virus (WSSV) confers protection against WSSV in *Penaeusvannamei* (Boone) post-larvae. Journal of fish diseases. 2006; 29: 589-600.

27. Robalino J, Browdy CL, Prior S, Metz A, Parnell P, Gross P, et al. Induction of antiviral immunity by double-stranded RNA in a marine invertebrate. J Virol. 2004; 78: 10442-10448.

28. Mejía-Ruíz CH, Vega-Peña S, Alvarez-Ruiz P, Escobedo-Bonilla CM. Double-stranded RNA against White Spot Syndrome Virus (WSSV) vp28 or vp26 reduced susceptibility of Litopenaeus vannamei to WSSV, and survivors exhibited decreased susceptibility in subsequent re-infections. J Invertebr Pathol. 2011; 107: 65-68.

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