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Translucent Post larval Disease (TPD) in Shrimp: An Emerging Challenge for Hatchery Health Management

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Abstract

Translucent Post-larval Disease (TPD) has recently been found as a significant challenge to shrimp aquaculture especially on early post-larval stages of *Penaeus vannamei*. It is characterised by glass like transparent organism, pale hepatopancreas, empty digestive tract, weak swimming and massive mortality that may reach 60-90% in a short duration. TPD was first reported in China in late 2019 and has spread swiftly to other areas of the world that are the biggest shrimp producers in Asia and other cases that were reported recently confirm that TPD is not limited only in China and is a major global biosecurity threat. TPD is caused by hypervirulent strains of *Vibrio parahaemolyticus*, which do not produce AHPND related toxins but have new virulence factors referred to as *Vibrio* high virulence proteins especially vhvp-2. Waterborne transmission and management related risk factors are also used to spread the disease through rapid transmission in hatcheries. There is still no specific treatment, but nowadays early diagnosis is important to reduce its effects as well as the need to adhere to biosecurity and enhanced hatchery management practices.

Key words: Translucent Post-larval Disease (TPD), *Penaeus vannamei, Vibrio parahaemolyticus,* Hatchery health management, vhvp-2, Emerging shrimp disease

Introduction

Shrimp aquaculture particularly of *Penaeus vannamei* is a major contributor to global seafood production but its sustainability is increasingly threatened by emerging hatchery level diseases (Zou *et al.*, 2020; Zhang *et al.*, 2024). One such emerging condition is Translucent Post-larval Disease (TPD), a highly lethal disease affecting shrimp post-larvae during early developmental stages.

TPD is characterized by a glass like transparent body, pale hepatopancreas, empty digestive tract, weak swimming behavior and rapid mass mortality often exceeding 60-90% within 24-48 hours (Zou *et al.*, 2020; Hao *et al.*, 2025). First reported in China in late 2019, the disease has since spread across major shrimp producing regions of Asia with recent confirmation outside China indicating a growing global biosecurity risk (Zhang *et al.*, 2024; Dinh-Hung *et al.*, 2025).

Unlike acute hepatopancreatic necrosis disease (AHPND), TPD is caused by distinct hypervirulent strains of *V. parahaemolyticus* that rely on novel virulence factors known as Vibrio high virulence proteins (vhvp) (Stef *et al.*, 2025). Since TPD strikes before pond stocking, it leads to seed rejection, production losses and reduced farmer confidence making it an emerging and serious challenge for shrimp hatchery health management (Zhang *et al.*, 2024).

Emergence of Translucent Post-larval Disease (TPD)

Translucent Post-larval Disease (TPD) was first recognized as a distinct disease of shrimp post-larvae in late 2019 from hatcheries in southeastern China. The

disease initially affected *P. vannamei* post-larvae at very early stages and caused sudden mass mortalities prompting detailed investigations into its origin (Zou *et al.*, 2020). TPD was transmitted quickly in key shrimp-producing provinces of China within a very short time due to the transfer of infected post-larvae and shared hatcheries (Zhang *et al.*, 2024).

Later reports were able to validate that the rapid development of TPD is closely linked to hypervirulent strains of *V. parahaemolyticus* harboring mobile virulence genes. The genes are present on plasmids and integrative mobilizable elements enabling horizontal transfer between the Vibrio populations and permitting the rapid spread within the hatcheries and between populations (Hao *et al.*, 2025). This genetic mobility is what accounts for the dramatic emergence of the same disease outbreaks in geographically remote areas.

Recent reports have confirmed the presence of TPD causing *V. parahaemolyticus* strains outside China, providing the first clear evidence that TPD is no longer geographically confined (Dinh-Hung *et al.*, 2025). TPD poses a serious threat to global shrimp seed production systems without early diagnosis, strict biosecurity and coordinated surveillance (Zou *et al.*, 2020; Zhang *et al.*, 2024).

Susceptible Host and Life Stages

Translucent Post-larval Disease (TPD) is a disease which overwhelmingly occurs in the initial stages of post-larval *P. vannamei* and thus shrimp hatcheries are especially susceptible to outbreaks. Most reported cases involve post-larvae between PL4 and PL15 with the highest mortality observed during the earliest stages of development (Zou *et al.*, 2020; Zhang *et al.*, 2024). Younger post-larvae exhibit rapid disease progression while older stages show relatively reduced susceptibility (Dinh-Hung *et al.*, 2025).

Strong stage specific vulnerability is attributed to the underdeveloped immune system and comparable weak hepatopancreatic system of the early post-larvae that undergoes damage with ease by the TPD linked toxins (Stef *et al.*, 2025). he disease disproportionately affects the availability of seeds and hatchery profitability because *P. vannamei* controls hatchery production in most of the world (Zhang *et al.*, 2024).

Clinical Signs and Gross Symptoms

Translucent Post-larval Disease is characterized by distinct and consistent clinical signs observed in affected shrimp post-larvae. Diseased fishes exhibit a pale or colourless hepatopancreas and digestive tract resulting in a transparent or glass like appearance of the body (Zou *et al.*, 2020; Zhang *et al.*, 2024). These changes are normally accompanied with less pigmentation of the abdomen and tail.

Behavioral symptoms of affected post-larvae show weak swimming activity, reduced feeding and lethargy with many individuals sinking to the bottom of rearing tanks because of impaired muscle function (Zou *et al.*, 2020). The onset of disease is fast and mortality rises sharply over 24-48 hours of the first appearance of the disease. In extreme situations, cumulative mortality can be up to 60-100% and in early stages of the post-larval period (Zou *et al.*, 2020; Dinh-Hung *et al.*, 2025).

Histopathological Features of Translucent Post-larval Disease

Histopathological examination of the post larval shrimp with Translucent post-larval disease indicates there is terrible damage of the hepatopancreas and midgut which are the primary target organs of the disease. Necrosis and widespread sloughing of epithelial cells that cover the hepatopancreatic tubules and the intestinal epithelium are the most reliable lesions that are identified (Zou *et al.*, 2020; Zhang *et al.*, 2024).

The degeneration of the tubular structure in the hepatopancreas, the destruction of the epithelial integrity and cellular debris in the hepatopancreatic lumen can be observed in both naturally and experimentally infected post-larvae. The midgut epithelium exhibits similar pathological changes including epithelial exfoliation and inflammatory responses which compromise nutrient absorption and digestive function (Zou *et al.*, 2020). Hemocytic infiltration and enteritis has also been reported in recent studies suggesting a robust host inflammatory response to infection (Dinh-Hung *et al.*, 2025).

The described histopathological changes are also the reason why the clinical progression of TPD is extremely rapid and fatal as widespread destruction of digestive tissues significantly affects metabolism and energy intake during early post-larval periods (Zou *et al.*, 2020; Zhang *et al.*, 2024).

Causative Agent and Virulence Mechanism

Translucent Post-larval Disease is caused by hypervirulent strains of *V. parahaemolyticus* that are genetically distinct from AHPND causing strains (Zou *et al.*, 2020; Dinh-Hung *et al.*, 2025). These strains do not contain any pirA/pirB-toxins but instead carry *Vibrio* high virulence protein (VHVP) genes with vhvp-2 being the key factor or determinant of lethality (Zhang *et al.*, 2024).

These VHVP toxins are Tc toxins that result in serious necrosis and sloughing of epithelial cells in the hepatopancreas and midgut with lethal consequences in early post-larval stages (Stef *et al.*, 2025). These virulence genes are carried on mobile genetic elements facilitating the transmission in horizontal within populations of Vibrio and helping in the fast emergence and dissemination of TPD in hatcheries (Hao *et al.*, 2025).

Transmission and Risk Factors

Translucent Post-larval Disease spreads rapidly within shrimp hatcheries, mainly through waterborne transmission and tank to tank contamination. Movement of infected post-larvae and the reuse of equipment facilitate the dissemination of TPD causing *V. parahaemolyticus* strains (Zou *et al.*, 2020; Zhang *et al.*, 2024). The presence of mobile virulence genes further enhances the spread of pathogenic strains among *Vibrio* populations (Hao *et al.*, 2025).

Outbreaks are commonly associated with high stocking density, elevated water temperature and deteriorated water quality which increase stress and susceptibility in early post-larval stages (Zhang *et al.*, 2024). These factors collectively create favorable conditions for rapid disease amplification in hatchery systems.

Diagnosis and Identification of TPD

Diagnosis of Translucent Post-larval Disease is primarily based on characteristic clinical signs and histopathological lesions observed in affected post-larvae (Zou *et al.*, 2020). Routine PCR screening of diseased samples is typically negative for major shrimp viral pathogens, helping to differentiate TPD from viral diseases common in hatcheries (Zou *et al.*, 2020).

The final diagnosis is based on the use of bacteria isolation and challenge tests, which identify the presence of *V. parahaemolyticus* strains that have vhvp virulence genes. Molecular identification of vhvp-1 and vhvp-2 genes is a strong instrument to verify TPD and differentiate it with AHPND that does not have these gene markers (Zhang *et al.*, 2024; Dinh-Hung *et al.*, 2025).

Control and Management of Translucent Post-larval Disease

Currently there are no particular therapeutic remedy for Translucent Post-larval Disease and thus prevention and control are important in hatcheries. As hypervirulent *V. parahaemolyticus* is the causative agent of TPD, the strict biosecurity protocols such as tank disinfection, water treatment and equipment hygiene are necessary to control the spread of the disease (Zou *et al.*, 2020; Zhang *et al.*, 2024).

t is not recommended to use antibiotics because their effectiveness is minimal and it is feared it may lead to antimicrobial resistance. Recent studies have demonstrated that natural antimicrobial formulations can significantly reduce virulence gene expression and improve post-larval survival during experimental challenges, highlighting their potential as alternative control strategies (Stef *et al.*, 2025). The early disease detection, lower stocking density and maintenance of optimal water quality are also the major aspects of effective TPD management (Dinh-Hung *et al.*, 2025).

Conclusion

The occurrence of Translucent Post-larval Disease has posed a severe hatchery level disease in shrimp aquaculture with high rates of mortality and lack of treatment methods. TPD, which is caused by hypervirulent strains of *V. parahaemolyticus* with vhvp virulence genes is a serious threat to the reproduction of shrimp seeds and the survival of hatcheries (Zou *et al.*, 2020; Zhang *et al.*, 2024; Dinh-Hung *et al.*, 2025).

Since it has the ability to transfer horizontally and has the potential to spread across geographical locations, it is important to get early diagnosis, biosecurity measures and improvement in hatchery management practices to ensure that future outbreaks are prevented. Continued research on pathogen biology, transmission dynamics and non antibiotic control strategies will be critical for mitigating the long-term impact of TPD on the global shrimp aquaculture industry (Stef *et al.*, 2025).

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