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White Feces Syndromes (WFS) in *Penaeus vannamei* grow out culture – disease of major concern

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Introduction

White feces syndrome (WFS) has emerged as a serious concern for global shrimp aquaculture in recent years. WFS affected shrimp excrete white feces and WFS affected ponds were observed with floating white fecal threads. It has been reported that the Thai production loss due to WFS was estimated to be about 10–15% in 2010. The syndrome has been reported both in cultured *Penaeus vannamei* and *P. monodon*. In India, since 2015, the occurrences of WFS were very severe in *P.vannamei* grow-out farms. The disease can cause moderate to severe economic loss by reducing the shrimp survival by 20–30% compared to the normal ponds.

Fig. 1: Shrimps from WFS affected pond show size variation (A), white gut (B, C)

Fig. 2: WFS affected pond show floating white feces on the pond's surface

Clinical signs

The shrimp affected with WFS can exhibit clinical signs as early as 20-30 days of culture. The WFS affected shrimp exhibit white/golden brown intestine, excrete white fecal threads and show reduced feeding and retarded growth. Ponds affected with WFS shrimp show floating white fecal threads on the surface of the pond for 10 to 45 days or more and will have increased FCR, size variation/growth retardation, loose shells and daily mortalities. The animal affected with loose shell show loose exoskeleton and sluggish swimming activity at the pond surface.

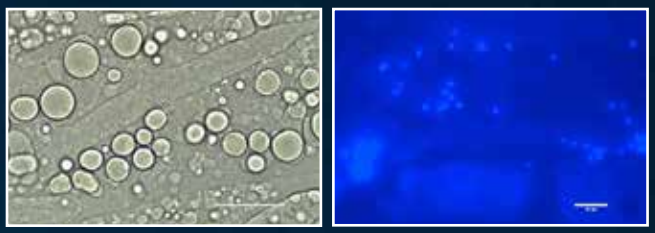

Fig. 3: A- Squash prepration of WFS affected HP show ATM structure (arrow), B- Histology section stained with calcoflour stain show the presence of EHP individual spores and spore clumps

Pathology

The squash and smear preparations of WFS affected shrimp hepatopancreas (HP) show vermiform bodies like aggregated transformed microvilli (ATM) structures inside the HP tubule lumen at lower magnification. At higher magnification (100x) dense EHP spore will be observed in and around the ATM structures in the HP tubule. Histology section stained with haematoxylin and eosin reveals the cross section of ATM structures. Histology section stained with calcoflour white stain reveals the presence of dense mature EHP spores and spore clumps in and around the ATM structures.

Causative agent

WFS incidences have been associated with gregarine worms, *vibrios*, ATM structures occurrences, *Enterocytozoon hepatopenaei* (EHP), bacteria, fungi and algae. However, white fecal strings are primarily composed of dense mature EHP spores, ATM structures, sloughed of epithelial cells, gut mucus, often accompanied by rod-shaped bacterium. ATM structures are vermiform bodies resembling gregarine worms that are formed due to aggregated transformed microvilli from hepatopancreatic epithelial cells. ATM structures are without any subcellular structures and lack nuclei, mitochondria and did not show any motility. Those vermiform bodies are only aggregated transformed microvilli (ATM) structures, not gregarine worms. Earlier, the severe occurrences of ATM structures were reported to cause WFS. However, the significant association of EHP with WFS has been

recorded in several studies.Consequently, ICAR-CIBA successfully reproduced WFS simultaneously with ATM structures and EHP by feeding EHP-infected HP tissues in experimental conditions. Also found that all WFS shrimp and white fecal strings from shrimp farms were found positive for EHP. Simultaneously WFS was successfully reproduced under laboratory conditions by infecting with EHP and *Vibrio parahaemolyticus* concurrently. Also, specific Propionigenium and specific *Vibrio* in combination with EHP were reported as potential component of EHP-WFS in *P.vannamei* grow out farms. The clinical manifestation of WFS is more complicated and similar to a clinical condition such as diarrhoea. Microsporidians are known to cause diarrhoea in human, pigs, cattle and honey bees. Thus WFS is a clinical condition caused by EHP in combination with *Vibrio sp.* / other pathogen.

Management

Feed can be reduced during the WFS affected period in shrimp ponds. Floating white fecal strings can be frequently removed from the shrimp pond on day to day basis. Neutraceuticals/feed additives which improve HP regeneration and epithelial cell proliferation might help the shrimp to recover from WFS condition in the affected ponds. Since the role of gregarine is negligible in WFS, anti-gregarine treatment may be avoided. Since EHP is significantly associated with the occurrences of WFS and considered as one among the cause of WFS. Hence the management measures recommended against EHP can be followed in WFS affected farms.

In hatcheries, the tanks, pipelines and other implements can be treated with 2.5% sodium hydroxide to eliminate EHP. In brood stock facilities EHP negative feeds can be used and live feed such as polychaete can be frozen (2h at -20^0 c), pasteurized or gamma irradiated. In grow-out ponds, EHP-free PL should be stocked in the ponds. Pond preparatory measures should be followed properly by drying and disinfection after every harvest. Calcium oxide (CaO) / quick lime at 6 tons / ha can be used by ploughing into 10-12 cm followed by moistening to activate the lime. Potassium permanganate > 15 ppm and Chlorine > 40 ppm can be used to inactivate the spores in the soil. Better management practices should be strictly followed.

Conclusion

White feces syndrome (WFS) has emerged as a major constraint for shrimp aquaculture. The syndrome is named as WFS, since the affected shrimps excrete white fecal strings. WFS is a clinical condition manifested by EHP in combination with *Vibrio* / unknown pathogen in EHP endemic countries. Consequently, the floating white fecal strings can be an indicator of EHP in shrimp culture. There is no specific therapeutics or treatment available for the control of WFS. Better management practices should be followed strictly for the prevention of WFS.

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