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Abdominal segment deformity disease (ASDD) of the whiteleg shrimp *Penaeus vannamei* reared in Thailand

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ABSTRACT

From 2004–2006, shrimp farmers in Thailand, Malaysia and Indonesia have complained of cultured whiteleg shrimp *Penaeus vannamei* that grow and survive normally but have abdominal segment deformity disease (ASDD). This is characterized by abdominal segments that are enlarged or twisted laterally and/or dorso-ventrally, sometimes accompanied by opaque muscles. Histological analysis revealed abdominal muscle necrosis and degeneration, with haemocytic infiltration. To study the cause, affected shrimp were tested by polymerase chain reaction (PCR) methods for the presence of known viruses including infectious hypodermal and haematopoietic necrosis virus (IHHNV), infectious myonecrosis virus (IMNV), *P. vannamei* nodavirus (*Pv*NV), *Macrobrachium rosenbergii* nodavirus (*Mr*NV), Taura syndrome virus (TSV) and Laem Singh virus (LSNV). Except a few shrimp that were positive for IHHNV, TSV and LSNV, the diseased shrimp were negative for all of the viruses tested. Their negative status was confirmed by *in situ* hybridization specific for IHHNV, IMNV, *Mr*NV, TSV and LSNV. By transmission electron microscopy (TEM), 20–22 nm, non-enveloped viral particles were observed in the cytoplasm of the muscle lesions, connective tissue and glial cells of neural tissues and gills. Affected neural tissues included the optic lobe, brain, thoracic ganglia, abdominal ganglia and ventral nerve cord. The findings suggest that ASDD in *P. vannamei* may be caused by a new virus that primarily invades neural tissue and results in neuromuscular dysfunction and abnormal morphology.

1. Introduction

Penaeus (Litopenaeus) vannamei is an economically important shrimp species that is currently cultured on a large scale in both the eastern and western hemispheres. However, it is native to the Pacific coast of the Americas and was introduced as an exotic species for Asian aquaculture in the late 1990s together with the pathogen Taura syndrome virus (TSV) (Tu et al., 1999). Since 2004, farmers from Thailand, Malaysia and Indonesia have reported a new disease condition in cultured *P. vannamei* characterized by abnormal segments that are swollen and bent laterally and dorso-ventrally, resulting in irregular shapes and irregular gut lines clearly observed through the transparent cuticle (Fig. 1). In addition for some shrimp, the abdominal muscle may be wasted and somewhat opaque, or the body may be reddish. The mean shrimp growth rate and shrimp survival are normal and the percentage of affected shrimp in the pond

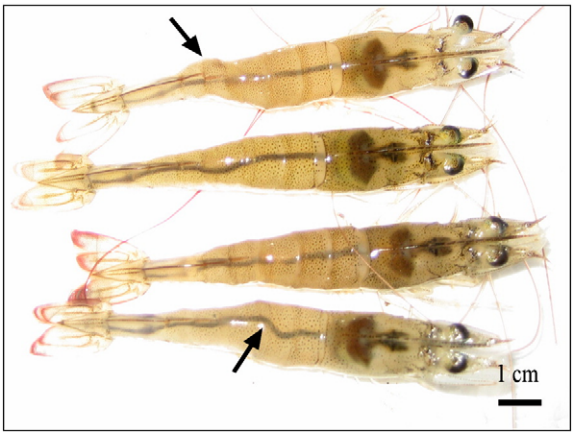

Fig. 1. Dorsal view of two-month old *Penaeus vannamei* suffering from ASDD. The deformities mainly involve abdominal segments and include sideways bending and dorso-ventral bending with opaque muscle in some shrimp. The gut line is jagged rather than straight when viewed from above (lower arrow). Bumpy surfaces (upper arrow) are also occasionally observed.

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varies between 5 and 60%. The distorted shapes can result in a reduced sale price of approximately 10% for affected shrimp.

When first noticed, the gross signs suggested to farmers and researchers that the shrimp might be infected with infectious hypodermal and hematopoietic necrosis virus (IHHNV) that is known to cause runt-deformity syndrome (RDS) in *P. vannamei* (Lightner, 1996a). However, the gross signs differed from those caused by IHHNV in that deformities did not include bent rostra or retarded growth normally associated with RDS (Lightner, 1996a). In addition, the affected shrimp gave negative results with polymerase chain reaction (PCR) tests for IHHNV (Chayaburakul et al., 2005). Except for occasional whitening of muscle tissue, nor did the affected shrimp show gross signs consistent with lesions caused by infectious myonecrosis virus (IMNV) of *P. vannamei* (Lightner et al., 2004a,b) or *P. vannamei* nodavirus (*Pv*NV) (Tang et al., 2007), especially with respect to lack of mortality. Another disease that causes muscle whitening is white-tail disease (WTD) in postlarvae and juveniles of the giant freshwater prawn *Macrobrachium rosenbergii* caused by *M. rosenbergii* nodavirus (*Mr*NV) and extra small virus (XSV) (Sri Widada et al., 2003). However, WTD causes high mortality, has not been associated with body deformity and has not been reported from *P. vannamei*.

Thus, because of the distinctive nature of the gross signs of this disease it was called abdominal segment deformity disease (ASDD) and this study was carried out to determine whether there was any evidence that it might be caused by an infectious agent. The shrimp were observed histologically for any known pathogens or other abnormalities and for viral pathogens by PCR methods, *in situ* hybridization (ISH) and transmission electron microscopy (TEM).

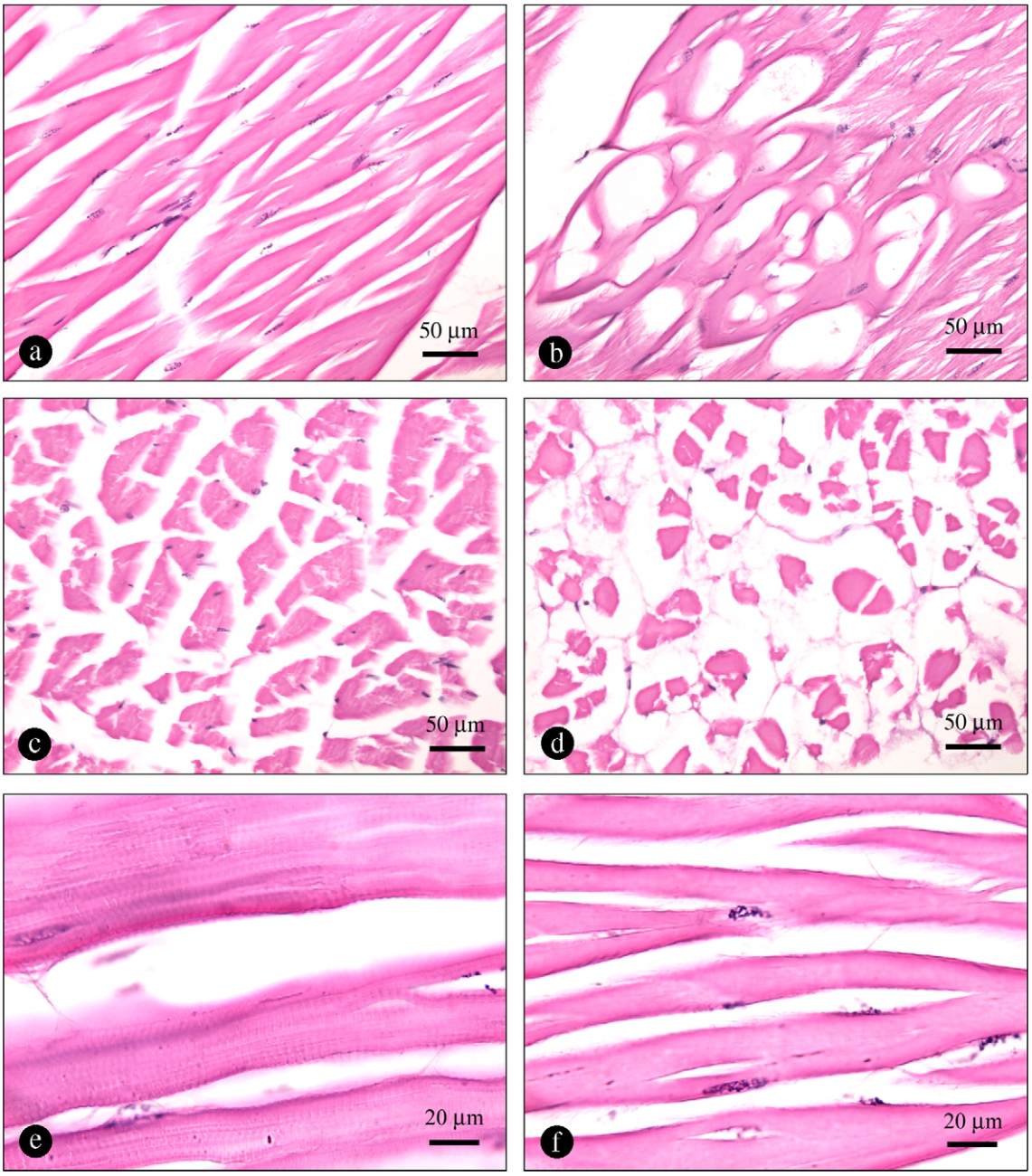

Fig. 2. Photomicrographs of the H&E stained muscle tissue from an ASDD shrimp specimen compared to that of a normal control shrimp specimen. Loss of myofibrils to produce empty spaces in longitudinal (b) and cross (d) sections can be seen in the ASDD shrimp specimen. Loss of muscle striation was occasionally observed (f).