Exposing the secrets of the nephrocomplex 1 ("antennal gland"): A major portal of entry for pathogens in Penaeus vannamei shrimp

G.M.A. De Gryse, V.K. Thuong, B. Descamps, W. Van Den Broeck, C. Vanhove, P. Cornillie, P. Sorgeloos, P. Bossier, <u>H.J. Nauwynck</u>^{*}

Laboratory of Virology, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke, Belgium

*Corresponding author, e-mail: hans.nauwynck@ugent.be

Abstract:

Viruses, such as white spot syndrome virus, and bacteria, such as Vibrio species, wreak havoc in shrimp aquaculture. As the main portal of entry for various pathogens in shrimp remain unclear, infectious diseases are difficult to prevent and control. Because the cuticle is a strong pathogen barrier, regions that lack cuticular lining, such as the shrimp's excretory organ, "the antennal gland", are major candidate entry-portals. The antennal gland, up till now morphologically underexplored, was studied using several imaging techniques. Using histology based 3D-technology, we demonstrated that the antennal gland resembles a kidney, connected to a urinary bladder with a nephropore (exit opening) and a complex of diverticula, spread throughout the cephalothorax. Micro Magnetic Resonance Imaging of live shrimp not only confirmed the histology-based model, but also indicated that the filling of the diverticula is linked to the molting cycle and possibly involved therein. Based on the hemolymph filtration function and attached diverticle complex, we propose to rename the antennal gland as the "nephrocomplex". By an intrabladder inoculation, we showed high susceptibility of this nephrocomplex to both white spot syndrome virus and Vibrio infection compared to peroral inoculation. An induced drop in salinity allowed the virus to enter the nephrocomplex in a natural way and caused a general infection followed by death; fluorescent beads were used to demonstrate that particles may indeed enter through the nephropore. These findings pave the way for an oriented disease control in shrimp.