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Codon-Optimized LvCTL3 Expression to Enhance Disease Resistance in Litopenaeus vannamei

Nguyen Xuan Huy

Hue University, Vietnam

Abstract

C-type lectins (CTLs) are critical components of the shrimp innate immune system, contributing to pathogen recognition, immune activation and microbial homeostasis. Among these, LvCTL3, a key C-type lectin in the whiteleg shrimp (Litopenaeus vannamei), is highly expressed in immune-related tissues, including the hepatopancreas and hemocytes. LvCTL3 supports innate immunity by recognizing pathogens, agglutinating bacteria (e.g., Vibrio spp., Bacillus subtilis), and aiding in the clearance of bacteria and viruses, such as white spot syndrome virus. In this study, the codon-optimized sequence of LvCTL3 for Escherichia coli expression was synthesized, cloned and expressed in E. coli BL21 (DE3) using the pCold DNA cold-shock expression system. High-level expression of the LvCTL3 protein was confirmed through SDS-PAGE and Western blot analysis with Anti-His Tag antibodies. The purified recombinant LvCTL3 protein was incorporated into basal diets to evaluate its effects on immune parameters, growth performance, and disease resistance in L. vannamei against Acute Hepatopancreatic Necrosis Disease causing Vibrio parahaemolyticus. Successful functional expression of LvCTL3 demonstrates its potential as a dietary supplement to enhance disease resistance in industrial shrimp aquaculture.