O-001.

Effect of a phytogenic feed additive on the growth performance and immunity of pacific white leg shrimp, *Litopenaeus vannamei*, fed a low fishmeal diet

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Abstract
Fishmeal has long been one of the most important ingredients in formulated aquafeeds, due to its high protein content, excellent composition of essential amino acids, and high digestibility. Increasing economic and ecological concerns regarding the use of fishmeal have encouraged the development of replacement strategies. Plant-derived products have been suggested to partially replace fishmeal in aquafeeds, however often at decreased growth performance, inflammatory responses, and increased susceptibility to diseases. This study assessed the effects of the commercial phytogenic feed additive Digestarom® PEP MGE on the growth, nutritional performance, and immune response of *Litopenaeus vannamei*. Juvenile shrimp (N=540) were stocked in 36 tanks (V = 100 L) for 63 days and fed one of the four experimental diets: i) standard formulation (control, 24% fishmeal), ii) low fishmeal diet (5%), iii) low fishmeal diet plus 0.2 g/kg Digestarom® PEP MGE, and iv) low fishmeal diet plus 0.4 g/kg Digestarom® PEP MGE. The results obtained after 63 days of feed supplementation suggest that the blend of essential oils tested compensated for the negative performance and health consequences of the low fishmeal diet. Particularly, the survival, FCR, total hemocyte count, and respiratory burst of the shrimp fed a low fishmeal diet supplemented with this phytogenic improved up to the levels recorded for shrimp fed a high fishmeal diet. Overall, results suggest that Digestarom® PEP MGE can be incorporated into shrimp low fishmeal diets to compensate for the negative performance and immunological effects of partially replacing fishmeal with plant-based protein.
Keywords: phytogenics, low fishmeal, white leg shrimp, growth performance, immunity

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O-002.

Membrane associated protein flotillin in *Litopenaeus vannamei* plays a role in WSSV infection

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Abstract
Flotillin, an important protein of vesicular endocytosis, plays an essential role in a large number of cellular processes, including viruses and pathogen infection. In the present study, a *flotillin-2* homolog in *Litopenaeus vannamei*, designed as *Lvflotillin-2*, was cloned and characterized. To analyze the putative role of Lvflotillin-2 during white spot syndrome virus (WSSV) infection, real-time quantitative PCR was performed. The result showed that the transcriptional level of *Lvflotillin-2* was up-regulated significantly after virus challenge. Furthermore, upon WSSV stimulation, Lvflotillin-2 in shrimp cells could translocate from the plasma membrane to intracellular compartments, and unexpectedly, also into nucleus. Additionally, depletion of *Lvflotillin-2* inhibited WSSV gene *ie1* transcription. These observations indicated that Lvflotillin-2 was involved in viral infection and WSSV stimulation resulted in its dynamic localization.
Keywords: Shrimp, flotillin-2, WSSV, endocytosis

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O-003.

Complexity of *Penaeus monodon* Dscam gene structure occurs in both extracellular region and cytoplasmic tail

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Abstract
In pancrustaceans, the Down syndrome cell adhesion molecule (Dscam) is an extraordinarily labile gene; thousands of isoforms can be generated by combining alternatively spliced exons from a single-locus gene. In insects, Dscam is involved in immunity as a hypervariable immune receptor. Similarly, we reported that Dscam was a hypervariable immune receptor in shrimp and crayfish. Interestingly, a unique tail-less Dscam identified in shrimp lacked a transmembrane domain and cytoplasmic tail. However, the mechanism to produce this unique tail-less Dscam is unknown. Here, we determined that the *P. monodon* Dscam (*Pm*Dscam) genome was ~250 kbp. The extracellular region had 10 immunoglobulin domains and six fibronectin III domains, i.e., [Ig1-Ig9]-[FNIII 1-FNIII 4]-[Ig10]-[FNIII 5-FNIII 6], with half of the second and third Ig domains and the entire Ig7 domain encoded by exon duplication. There were 26, 81, and 26 alternatively spliced exons in the Ig2, Ig3, and Ig7 domains, respectively, with potential to generate >54,000 protein isomorphs in the extracellular region of *Pm*Dscam. A very complex cytoplasmic tail structure was retrieved from this gene organization analysis. We identified three stop codon sites on the single gene sequence; furthermore, several exons encoded for cytoplasmic tail have also been identified. Taken together, *Pm*Dscam has potential to generate >21,000,000 unique isoforms via alternative splicing of both extracellular region and cytoplasmic tail, the highest potential number of isoforms among those crustaceans. In conclusion, we inferred that shrimp Dscam can use an alternative splicing event to produce selective isoforms against pathogens. Furthermore, Dscam may mediate specific immune responses in shrimp.
Keywords: Dscam, gene structure, genome, immunoglobulin family, shrimp

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O-004.

Artemia bioencapsulation delivers sulfated galactans to tissues and activates the expression of immune genes in shrimp

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