Multi-tissue mode of action of a phytobiotic-based health additive supporting growth and resilience in shrimp

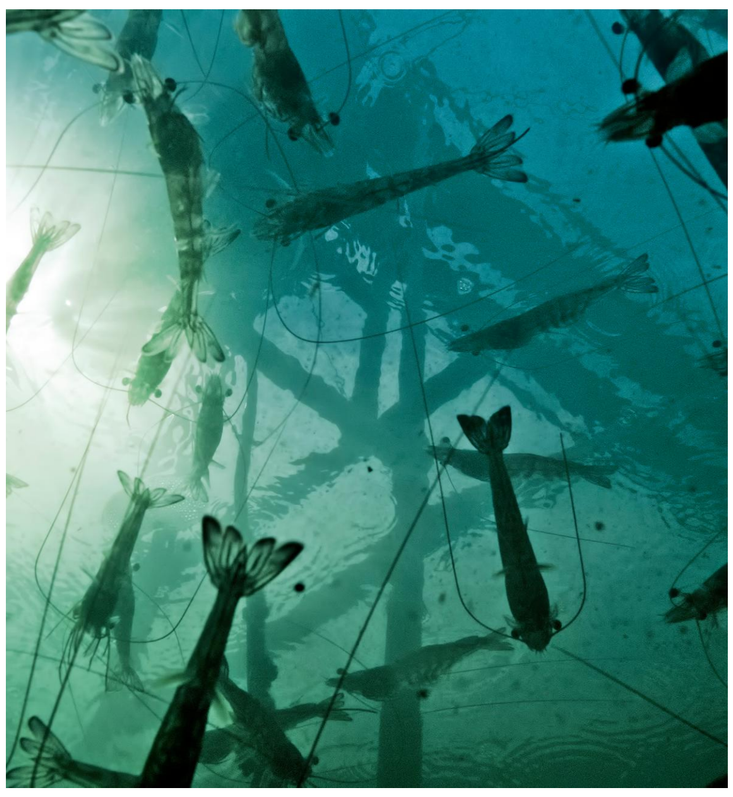
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Introduction

Health-promoting additives are increasingly used as part of preventive strategies to support shrimp resilience. However, while improvements in growth performance are often observed, the biological mechanisms behind these responses are not always fully described. Sanacore GM, a phytobiotic-based functional additive, is designed to support shrimp health through multiple biological functions, including gut health protection and immunocompetence under production challenges.

Understanding how it regulates shrimp physiology at the molecular level helps clarify its role in supporting growth and animal resilience.



Objective

This study evaluated the effects of Sanacore GM (Adisseo) on growth performance and tissue-specific gene expression in *Penaeus vannamei*, focusing on the hepatopancreas and intestine as key organs involved in metabolism and immune function.

Material & Methods

Juvenile *Penaeus vannamei* with an initial body weight of 2.3 g were reared in a RAS system and fed with the control diet or the same diet supplemented with 0.3% Sanacore GM by top-coating for 21 days.

Growth performance: Average daily growth, feed conversion ratio and final body weight were recorded.

Multi-tissue transcriptome analysis: Hepatopancreas and intestine were collected after 21 days of feeding and analyzed by RNA sequencing. Libraries were prepared using TruSeq Stranded mRNA and sequenced on the NovaSeq 6000 platform with paired-end 150 bp reads.

Pathway analysis: Differentially expressed genes were selected using $|\log_2 FC| > 1$ and $p < 0.05$, followed by KEGG pathway enrichment analysis.

Results & Discussion

Supplementation with the additive improved growth performance

After 21 days, supplemented shrimp showed better growth and feed efficiency than the control group, with ADG increased by 7%, final body weight by 5%, and FCR improved by approximately 5%. These results support the effect of the additive on shrimp performance.

Transcriptome analysis revealed clear tissue-specific responses

RNA sequencing generated approximately 25 million clean reads per sample and identified more than 13,000 genes.

Principal component analysis (PCA) showed clear separation between hepatopancreas and intestine, as well as between control and supplemented shrimp, indicating tissue- and diet-specific molecular responses (Fig.1).

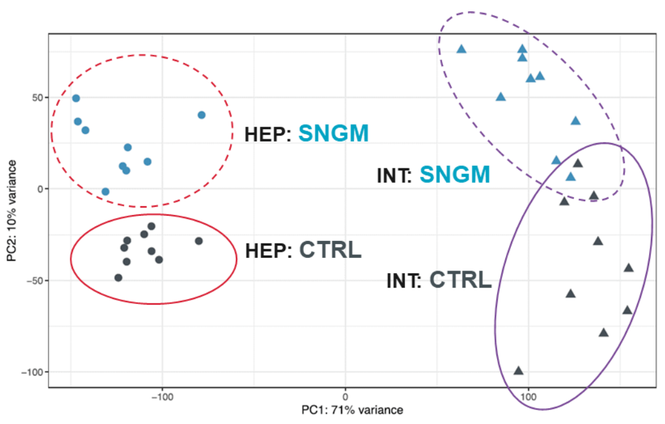


Figure 1. PCA showing tissue- and diet-specific transcriptomic responses.

Comparative transcriptome analysis showed a stronger molecular response in the hepatopancreas than in the intestine. In the hepatopancreas, 1,300 genes were differentially expressed, corresponding to 42 enriched KEGG pathways. In the intestine, 309 genes were differentially expressed, corresponding to 14 enriched pathways (Fig. 2)

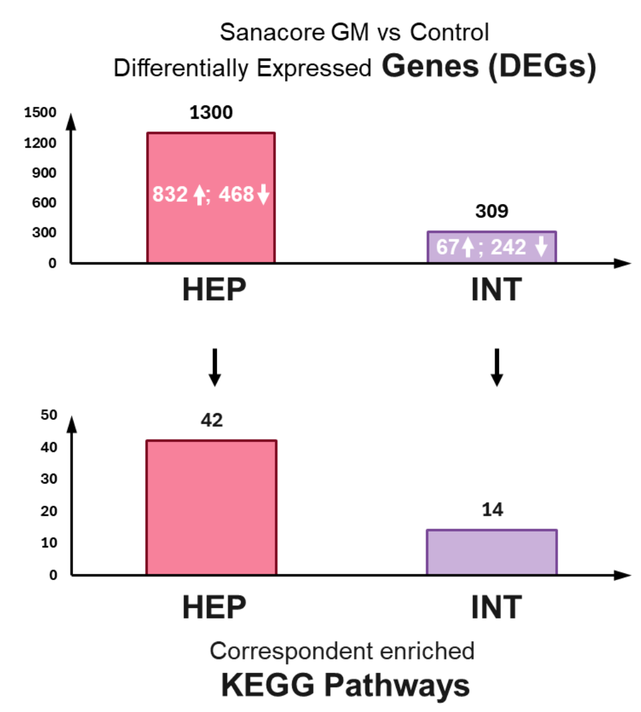


Figure 2. Differentially expressed genes and enriched KEGG pathways in hepatopancreas and intestine.

Functional classification emphasized the central role of the hepatopancreas

KEGG classification showed that metabolism dominated in both tissues, accounting for 55% of enriched pathways in the hepatopancreas and 71% in the intestine.

In contrast to the intestine, the hepatopancreas also showed a strong gene expression-related response, representing 31% of enriched pathways. This suggests activation of cellular machinery involved in transcription, translation and protein synthesis.

Together with DNA repair, lipid metabolism, antioxidant, autophagy and immune-related pathways, these responses highlight the hepatopancreas as the main regulatory tissue supporting improved growth performance and resilience.

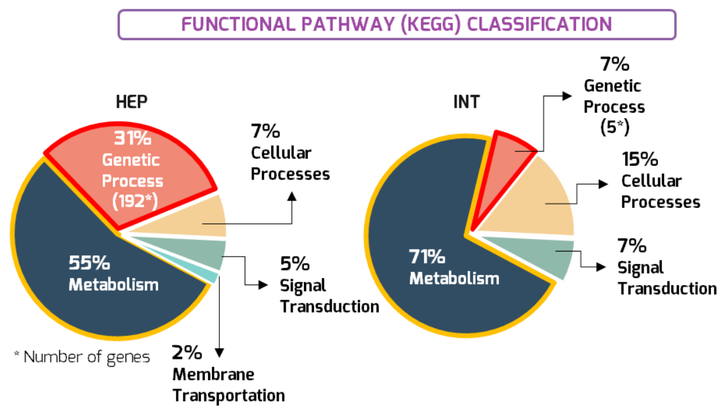


Figure 3. KEGG classification highlighting tissue-specific functional responses.

Conclusion

Sanacore GM induced a coordinated multi-tissue response in shrimp, supporting growth and resilience from the hepatopancreas to the intestine. By activating pathways related to protein synthesis, energy metabolism, DNA repair, lipid metabolism, antioxidant defense and immune function, the health promoting additive helps build a stronger physiological foundation for performance. These findings support its use as a preventive nutritional strategy to improve shrimp robustness under disease and environmental challenges.

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