Effects of dietary supplementation of protein hydrolysates on growth performance, feed utilization and disease resistance against *Vibrio parahaemolyticus* in pacific white shrimp (*Penaeus vannamei*)

Mirasha Hasanthi[1], Mikael Herault[2], Vincent Fournier[2] and Kyeong-Jun Lee[1,3,*]

[1] Department of Marine Life Science, Jeju National University, Jeju 63143, South Korea
[2] Symrise Aqua Feed, ZA du Gohelis, Elven 56250, France
[3]Marine Science Institute, Jeju National University, Jeju 63333, South Korea
[*]Corresponding author: kjlee@jejunu.ac.kr

Abstract

The study investigated the effects of dietary supplementation of protein hydrolysates on growth performance, feed utilization and pathogenic resistance in Pacific white shrimp. A diet containing 1% krill meal was considered as a control diet. Five other diets were formulated to be isonitrogenous (40% protein) and isolipidic (9.7% lipid) including 2% tuna hydrolysate, 2% tuna+shrimp liquid hydrolysate blend, 1% shrimp powder, 1% fish powder and 2% shrimp liquid hydrolysate. Each diet was fed to quadruplicate groups of 30 juvenile shrimp (initial weight 0.4±0.0 g) for 10 weeks. After the feeding trial, 45 shrimp from each dietary treatment were redistributed into three replicate tanks for the *Vibrio parahaemolyticus* bacterial challenge. The result showed that shrimp fed tuna hydrolysate and shrimp powder supplemented diets had significantly increased ($P < 0.05$) weight gain compared to shrimp fed krill meal diet. Feed conversion ratio was significantly decreased ($P < 0.05$) with all the dietary protein hydrolysates, whereas shrimp powder showed the lowest level. Shrimp survival against *V. parahaemolyticus* challenge was positively influenced by the dietary protein hydrolysates. The survival was significantly higher ($P < 0.05$) in shrimp fed shrimp powder than in shrimp fed krill meal. These results demonstrate that protein hydrolysate supplementations in diets could improve the growth, feed utilization and disease resistance of shrimp.

Introduction

The aquaculture industry has been expanding rapidly, driven by the increasing global demand for fish and seafood. A primary concern in aquaculture is finding alternative protein sources for fish meal that are both sustainable and nutritionally adequate. One promising alternative is marine protein hydrolysate (MPH), derived from the enzymatic hydrolysis of marine by-products. The sources of MPHs are often by-products from the seafood processing industry, making them a sustainable option for aquafeed formulations. As by-products several commercial species such as tuna tilapia, marine bony species, salmonids, shrimp, marine invertebrates such as mollusks, squid, and cuttlefish and underutilized fish have been used. These hydrolysates contain peptides with 2–10 amino acids or up to 20 amino acids and a molecular weight of <3 kDa, especially between 0.2 to 2 kDa. MPHs are rich in easily digestible nutrients, including essential amino acids, peptides, and other bioactive compounds. Hence, they have been reported to possess physiological and biological functions including enhanced digestibility and absorption, enhance palatability, promote growth performance, immunomodulatory, antimicrobial or antioxidant activities. Therefore, the aim of the present study was to evaluate the supplemental effects of five different types of protein hydrolysates including tuna, tuna+shrimp, shrimp powder, fish powder, and shrimp liquid hydrolysate in low FM diets and to compare their efficiency with KM diet.

Materials and Methods

Experimental setting:

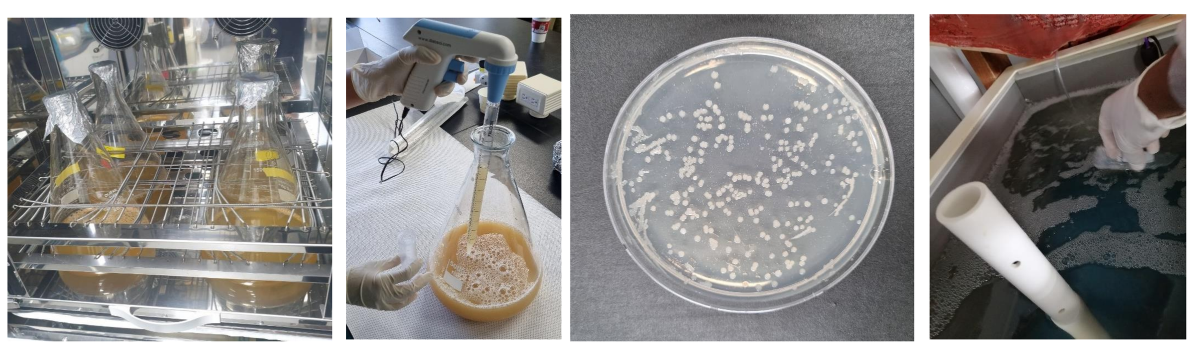
- Dietary treatments: 1% krill meal, 2% tuna hydrolysate, 2% tuna+shrimp liquid hydrolysate, 1% shrimp powder, 1% fish powder, 2% shrimp liquid hydrolysate
- 6 treatment ×4 replicates =24 tanks
- Initial weight : 0.4 g
- Stocking density: 30 shrimp/ tank (240L)

Feeding trial:

- Duration: 10 weeks
- Feeding: 6 times per day
- Rearing water condition: temperature, 30.1 ± 1.4°C; DO, 7.1±0.5 mg/L

Analysis:

- Growth performance, feed utilization, and resistance against *Vibrio parahaemolyticus*



Challenge test against *Vibrio parahaemolyticus*

Table 1. Formulation of experimental diets for Pacific white shrimp (%, DM basis)

	Krill meal	Tuna Hyd	Tuna/ shrimp Hyd	Shrimp powder	Fish powder	shrimp Hyd
Tuna meal	9.00	9.00	9.00	9.00	9.00	9.00
Krill meal	1.00					
Tuna Hyd		0.55				
Tuna/ shrimp Hyd			0.58			
Shrimp powder				1.00		
Fish powder					1.00	
shrimp Hyd						0.42
Corn gluten	3.00	3.00	3.00	3.00	3.00	3.00
Wheat Gluten	3.00	3.00	3.00	3.00	3.00	3.00
Soybean meal	48.22	48.85	48.90	47.95	47.85	49.08
Wheat flour	16.11	15.98	15.95	16.33	16.33	15.91
Starch	4.86	4.68	4.61	4.82	4.94	4.65
Soybean oil	1.72	1.57	1.59	1.53	1.50	1.57
Fish oil	4.00	4.20	4.20	4.20	4.20	4.20
Lecithin	0.77	0.85	0.85	0.85	0.86	0.85
Mineral Mix	2.00	2.00	2.00	2.00	2.00	2.00
Vitamin Mix	1.00	1.00	1.00	1.00	1.00	1.00
Cholesterol	0.07	0.07	0.07	0.07	0.07	0.07
Choline chloride	1.00	1.00	1.00	1.00	1.00	1.00
MCP	3.00	3.00	3.00	3.00	3.00	3.00
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Guar gum	1.00	1.00	1.00	1.00	1.00	1.00
Proximate composition (%, dry matter)						
Dry matter	93.4	93.3	93.2	93.2	93.0	93.2
Crude protein	38.2	38.4	38.9	38.4	38.8	38.3
Crude lipid	8.78	8.93	8.74	8.81	8.92	8.96
Ash	11.0	11.0	11.2	11.1	11.0	11.2

Results

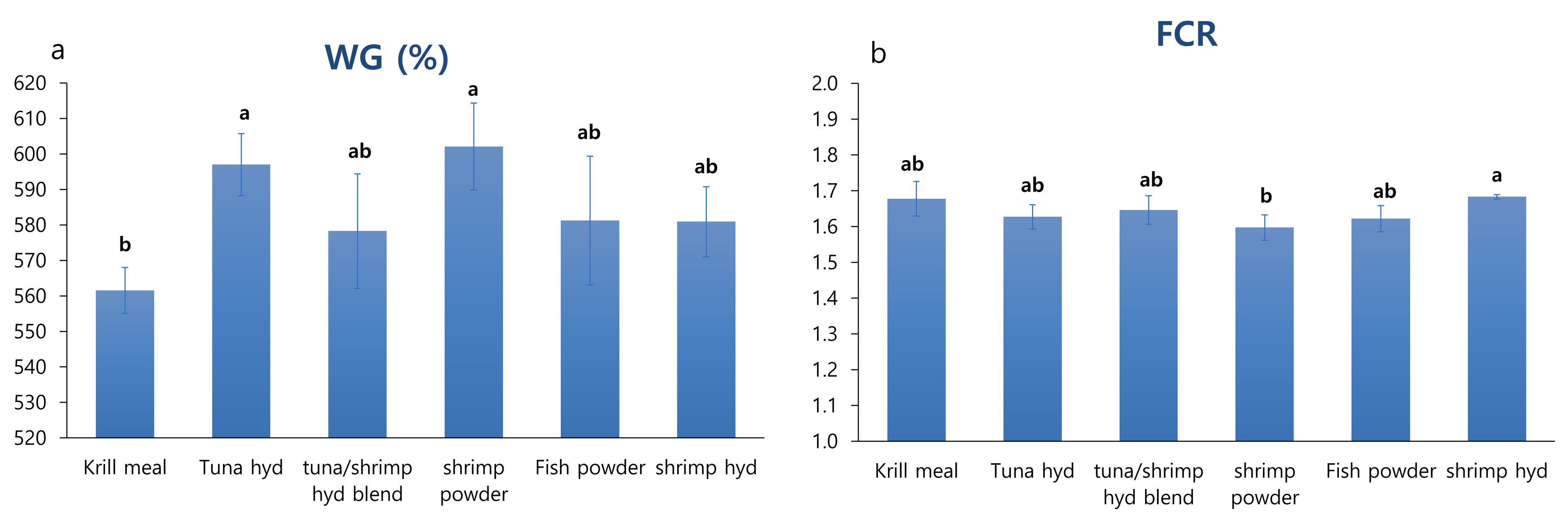


Figure 1. Growth performance and feed utilization efficiency of shrimp after the 10 weeks of feeding trial

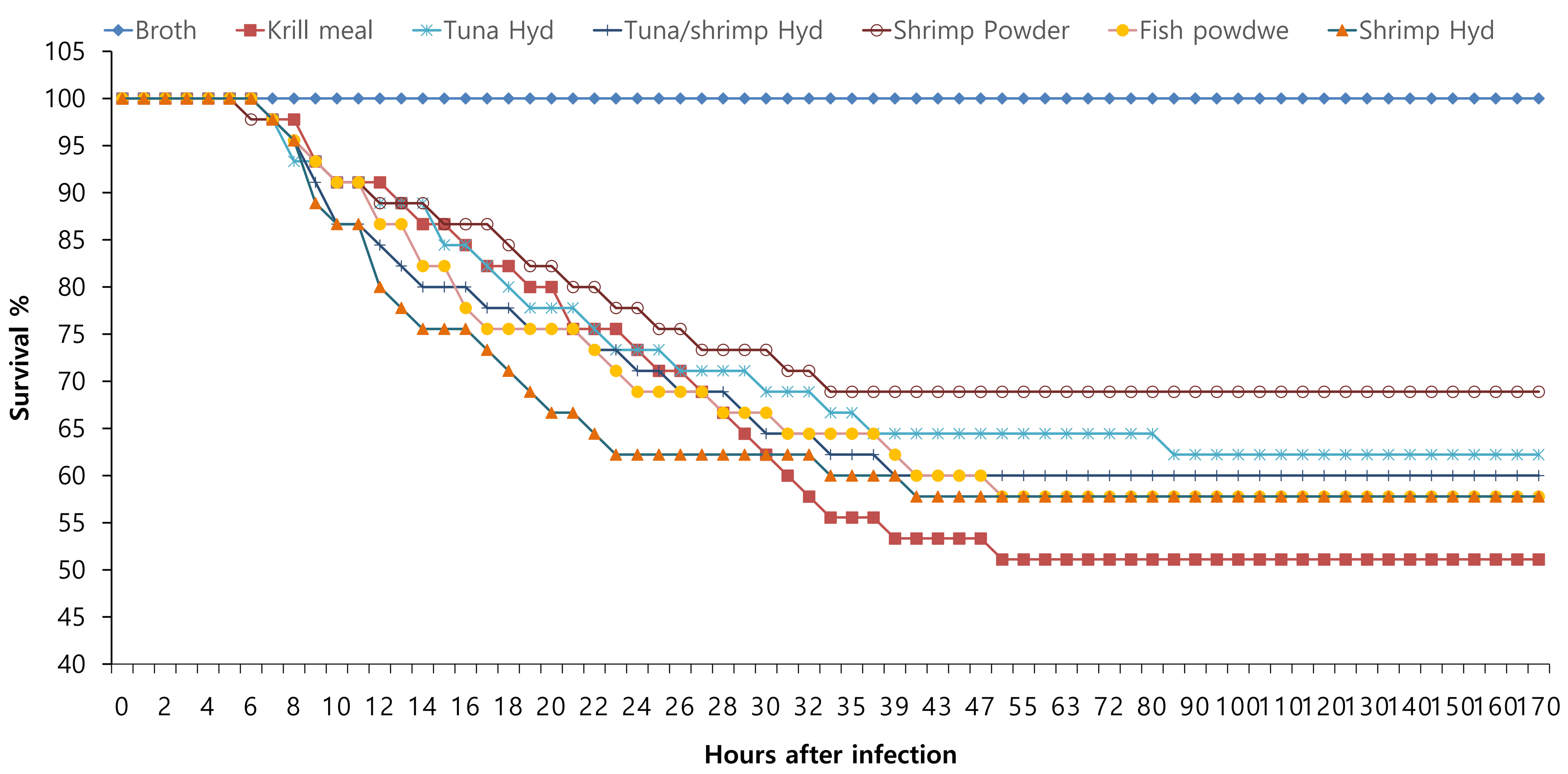


Figure 2. Shrimp survival against *Vibrio parahaemolyticus* (1.83×10^5 CFU/mL) bacterial challenge after 10 weeks of the feeding trial.

Conclusion

- Supplementation of tuna hydrolysates, shrimp hydrolysates, and shrimp and fish hydrolysate powder into low FM diet could improve the growth, feed utilization, and disease resistance against *Vibrio parahaemolyticus* of Pacific white shrimp.