水研機構研報，第50号，159－160，令和3年
Bull. Jap. Fish. Res. Edu. Agen. No. 50, 159－160, 2021

Development of a sustainable diet for Japanese white trevally *Pseudocaranx dentex* juveniles

Jonas MILLER*1, Shuhei TANAKA*1, Hiroki KIHARA*1, Shinichi YAMADA*1, Fumiaki TAKAKUWA*1, Keitaro KATO*2, Amal BISWAS*1, and Hideki TANAKA*1

Extended Abstract

The Japanese white trevally *Pseudocaranx dentex, Shimaaji* in Japanese, (Bloch & Schneider, 1801) is a highly prized carangid fish species for sushi and sashimi that is distributed in tropical and temperate waters around the world, except in the eastern Pacific region. There is an increased demand for the white trevally due in part to the increase in artificially hatched fingerlings which are only cultured in Japan. Overall, published studies on the nutritional requirements of juvenile white trevally are limited and there is ongoing research being conducted to determine the most suitable protein sources for developing a practical diet.

In Japan and around the world, the primary commodity utilized for protein in aquaculture feed formulations is fish meal (FM), which is produced from the mass-catch of pelagic fish species. FM tends to have high cost oscillations, and its high level of inclusion in marine fish diets tends to have negative consequences on the environment, including phosphorus pollution from the effluent of fish fed FM-based diets. Soybean meal (SBM) is an alternative protein source that is a promising candidate for FM replacement in juvenile white trevally diets. In general, marine fish species tend to exhibit varied sensitivity to SBM due to the presence of phytic acid and other antinutritional factors, which can contribute to issues related to low palatability, further leading to poor growth due to deficiency of indispensable amino acids such as methionine and lysine. However, the amino acid, palatability and anti-nutritional factors associated with SBM could be overcome with the addition of supplemental crystalline amino acids, taurine, phytase supplementation, and palatability enhancers by developing an appropriate feed formulation the white trevally.

In the aquaculture industry, the flavor attractant krill meal (KM) is utilized as a high-level protein source and palatability agent for juvenile marine fish. In order to formulate a low-cost and environmentally sustainable diet for juvenile white trevally, it is necessary to find a suitable replacement for KM that serves as a high-quality protein source, has a well-balanced amino acid profile, and works well as a flavor attractant. Furthermore, it is necessary to develop a feed formulation that completely replaces FM in practical diets. Land animal by-products have potential as alternative feed ingredients in formulated diets for marine fish. One of the most noteworthy animal by-products is poultry by-product meal (PBM), which consists of rendered waste material generated from poultry slaughterhouses and processing plants. PBM, which has a good amino acid balance and high protein content has yet to be tested in in practical SBM-based diets for juvenile white trevally as a protein source and palatability agent.

Three feeding trials conducted at the Aquaculture Research Institute of Kindai University from 2018—2020 demonstrated that high levels of SBM replacement by FM in combination with palatability enhancers KM or PBM, indispensable amino acids Lys and Met, taurine, and phytase in the diets provided high utility when fed to juvenile Japanese white trevally. While SBM has been mostly considered as an inferior protein source to FM when included in marine fish aquaculture

2020年12月11日受理（Accepted on December 11, 2020）
*1 Uragami Station, Aquaculture Research Institute, Kindai University, 468-3 Uragami, Nachi-katsuura, Higashimuro, Wakayama 649-5145, Japan
*2 Shirahama Station, Aquaculture Research Institute, Kindai University, 1-5 Shirahama, Nishimuro, Wakayama 649-2211, Japan
E-mail: hidektana "at" gmail.com

diets, the results of the three feeding trials revealed great potential for SBM as an FM replacer. It is evident that Japanese white trevally is an excellent candidate for alternative protein sources derived from plants including SBM. The diets tested provided high survival and adequate growth rates to warrant further development of practical diets for this species. Fish fed diets containing higher levels of SBM had a lower environmental impact than fish fed with FM-based diets, which highlights the ecological benefits of utilizing alternative protein sources. It is recommended that future research focuses on determining a mechanism to understand why juvenile white trevally achieve better growth performance with higher levels of SBM than FM in the diet. The results from the three feeding trials mentioned above will be described in future publication.

Annotated Bibliography of Key Works

(1) Biswas A., Araki H., Sakata T., Nakamori T., Kato K., and Takii K., 2017: Fish meal replacement by soy protein from soymilk in the diets of red sea bream (*Pagrus major*). *Aquac. Nutr.*, **23**, 1379–1389.

The results of this study introduce the ecological benefits of replacing FM by soy-based products in juvenile red sea bream, such as reduced phosphorus discharge to the environment. This feeding experiment was conducted at the Aquaculture Research Institute of Kindai University, Japan using the same methods that were utilized in the research presented in our extended abstract.

(2) Jirsa D., Davis A., Stuart K., and Drawbridge M., 2011: Development of a practical soy-based diet for California yellowtail, *Seriola lalandi*. *Aquac. Nutr.*, **17**, e869-e874.

This study was carried out in an effort to develop an environmentally sustainable and cost-effective diet for California yellowtail juveniles using soy products to replace fish meal. This research used a similar approach in terms of feed formulation, specifically investigating the utility of soybean meal and soy protein concentrate. Interestingly, fish fed diets containing soybean meal outperformed fish fed soy protein concentrate, which further influenced our choice of testing the utility of conventional soybean meal on white trevally juveniles. This research was conducted in the United States.

(3) Kader Md. A., Bulbul M., Koshio S., Ishikawa M., Yokoyama S., Nguyen B.T., and Komilus C. F., 2012: Effect of complete replacement of fishmeal by dehulled soybean meal with crude attractants supplementation in diets for red sea bream, *Pagrus major*. *Aquaculture*, **350–353**, 109–116.

The authors found that in red sea bream juveniles, nutrient utilization, body composition and blood parameters were improved or not significantly affected by replacing fish meal with soybean meal in combination with flavor attractant supplementation. Growth performance results from this experiment express a similar trend to the results presented in our abstract, in which soybean meal diets outperformed the fish meal control diets in white trevally. This research was conducted in Japan.