## Terrestrial animal- and plant-based ingredients as alternative protein and lipid sources in the diets for juvenile groupers: Current status and future perspectives

## Abstract

The Epinephelinae groupers are strict carnivorous species. They are widely cultured in the Asia Pacific region as a result of high demand and market price especially in the live reed food fish trade. Groupers are commonly raised in net cages and fed with the unsustainable low value fish. Although this feeding practice has been gradually improved by using formulated diets, the production cost of these diets is high due to the increasing prices of fish meal and fish oil. In order to find sustainable replacements for these expensive commodities, research has been conducted to evaluate alternative ingredients effects on fish growth performances and immune function. This review covers different types of alternative ingredients tested on several species of juvenile grouper. In general, animal protein sources were able to replace fish meal at higher inclusion levels than plant protein sources. Lowered digestibility, deficiency in essential nutrients, and reduced palatability are major challenges in using alternative ingredients in grouper feeds.