SPECIAL REPORT

Alternative feed ingredients to reduce aquaculture's dependence on wild fish

by SEAFDEC/AQD

A paradox in seafood production highlights the need for alternatives to fish-based ingredients in aquaculture feed. Aquaculture has generally been seen to provide for the fish that could no longer be provided by the overharvested oceans. However, the dramatic growth of the industry has been achieved at the expense of millions of tonnes of fish caught from the oceans. Small marine fish and bycatch are important resources to derive fish meal and fish oil which are primary sources of protein and fatty acids for aquaculture feed.

While the sources of fish meal and fish oil are usually not for human consumption, the ecological impact of an ever-increasing demand to supply the growing aquaculture industry calls for a shift away from the unsustainable practice. To provide for the protein and oils in aquaculture feed, alternative sources have been sought to replace fish meal and fish oil, whether partially or totally.

The need for alternative feed ingredients is underlined by the rising cost of fish meal and fish oil. Already, feeds can account for over 50 % of the production cost in fish farms. While plant-based protein sources such as soybean meal and wheat gluten have provided lower-cost alternatives, volatile prices have incentivized the continuing search for still more alternative feed ingredients. Southeast Asia is rich in the diversity and quantity of resources that could hold potential to substitute for fish meal and fish oil. Locally-available ingredients further provide the added benefits of cost savings and reduced imports.

Advances in feed development have identified several alternative sources of protein. Terrestrial plant-based sources, as the most abundant substitute for fish meal, unfortunately tend to have a highly variable nutrient profile, lack essential amino acids, and contain anti-nutritional factors. Because of these, their ability to substitute fish meal is limited. However, advances in feed processing technologies leave much potential to improve their nutrient profile and the removal of anti-nutritional factors.

Terrestrial animal sources comprise another group of alternative feed ingredients. Meat meal, poultry meal, bone meal, feather meal, and blood meal offer good protein content and better palatability among farmed fish. Seafood by-products from processing plants include shrimp heads and shells. These have high protein content but are prone to spoilage.

Meanwhile, there are also non-conventional sources of protein such as snails, worms, frogs, and maggots. Very promising sources are single-cell microorganisms such as yeast and algae which could further provide probiotic effects and enhance the nutritional value of fish meat.

R&D on alternative feed ingredients at AQD

SEAFDEC/AQD has been doing extensive research and development on nutritional requirements, alternative feed ingredients and their digestibility, and developed suitable feed formulations for a wide range of aquaculture species at various growth stages.

Agricultural wastes, such as mango peels, may be a future source of nutrition for feeds

Soybeans are major source of non-fish protein for feeds

In recent years, AQD has been testing agro-industrial wastes and byproducts (mango peel silage, soybean curd residues, and citrus byproducts) for suitability as protein source for tilapia breeders and fingerlings. Protein-enhanced copra meal was also analyzed and tested as protein source for grouper (*Epinephelus coioides*). For the abalone (*Haliotis asinina*) breeder diet, the algae thraustochytrid was tested for means to enhance its lipid content. A hydrolysate of milkfish byproducts, with its rich protein content, was also evaluated as a potential feed ingredient for pompano (*Trachinotus blochii*) and tilapia diets.

Promising results were obtained from distillers dried grain solubles (DDGS), a byproduct of the distillery industry,

which was shown to significantly improve milkfish growth. A dried form of the seaweed *Ulva pertusa*, when enriched with ammonium chloride, was found to be an effective protein source for abalone.

Field testing of low-cost milkfish and tilapia feeds

Alternative feed ingredients not only reduce aquaculture's demand for wild-caught fish but also provide economic benefits in reducing the cost of feeds. This year, preliminary data on the comparative performance between a commercial diet and a low-cost grow-out diet formulation by AQD has resulted in similar harvest weight in milkfish. While providing similar growth performance, the low-cost diet presented 29 % savings in feed cost. Should the savings be passed on to end-consumers, alternative feed ingredients and proper formulation hold much potential to improve food security and quality among the lower-income sectors.

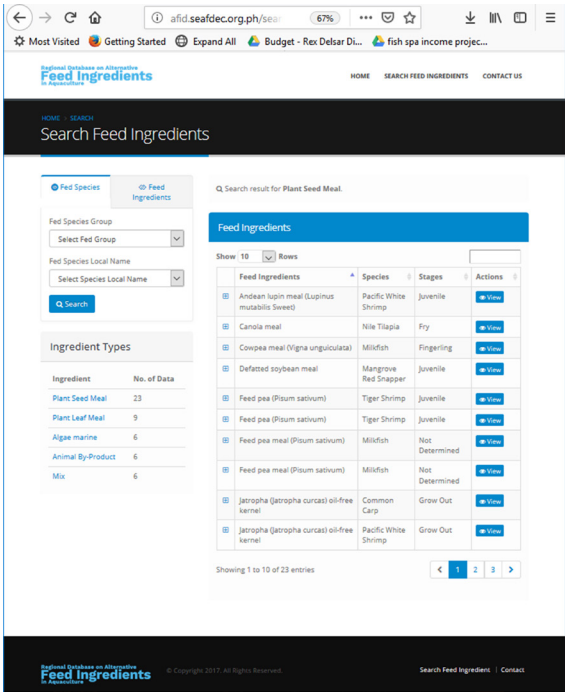
In the pipeline are cheaper and sustainable feed for milkfish and tilapia that will be verified at various grow-out facilities of Bureau of Fisheries and Aquatic Resources-National Fisheries Research and Development Institute (BFAR-NFRDI) in the Philippines. Ingredient components such as DDGS, poultry byproduct meal, and protein enhanced copra meal (PECM) will be incorporated in the diets. A training course for technicians who will be involved in the project on Aquaculture Feeds and Feeding Management will be conducted prior to the start of the project, since a cost efficient feed should be complemented with appropriate knowledge and skills in feeding management.

Formulated feeds at AQD with alternative ingredients

Online database of alternative feed ingredients

Numerous alternative feed ingredients have so far been identified and tested. However, their successful incorporation in feeds would still depend on multiple factors such as their unique nutritional values, feed preference of the target species, ingredient's digestibility as well as the availability and cost of the ingredient when needed by feed processors. Because of these many factors, a comprehensive knowledge on tested alternative ingredients is needed to guide researchers and feed formulators.

During the ASEAN-SEAFDEC Regional Technical Consultation on Development and Use of Alternative Dietary Ingredients or Fish meal Substitutes in Aquaculture Feed Formulation held in Myanmar in 2014, it was recognized that such information is difficult to access. It was recommended to compile and disseminate available information on alternative feed ingredients.



Regional Database of Alternative Feed Ingredients in Aquaculture accessible at http://afid.seafdec.org.ph

After the regional workshop in Bangkok, Thailand in May 2018, which was participated in by representatives from ASEAN Member States, the Regional Database of Alternative Feed Ingredients in Aquaculture was officially launched by SEAFDEC/AQD in July 2018. The database, accessible at *http://afid.seafdec.org.ph,* is intended to serve as a reference for the different feed ingredients that, depending on cost and availability, may be used to produce cheaper feed. The database currently lists over 70 different feed ingredients along with their nutritional composition and optimal inclusion levels. Results of feeding trials on fish species is also included where available. The data have been culled from over 100 published scientific papers on fish nutrient substitutes which were found effective for commercial applications.

More alternative feed ingredients will soon be added to the Database as representatives from SEAFDEC Member Countries have also been tasked to contribute information regarding their respective local ingredients. With further development, the public will also be invited to submit their inputs to further expand the breadth of the database. The Database is a collaborative effort between SEAFDEC/AQD and SEAFDEC Member Countries with funding support from the Japanese Trust Fund.