

Enhancing aquaculture sustainability through development of novel fish-feed

Developing technologies to enable the replacement of fishmeal with plant protein sources that provide superior protein conversion, growth and meat quality in farmed fish

The need

There is a well recognised need to reduce the current dependence on animal feed imports in the UK and Europe, which are only c.30% self-sufficient in domestic production. The aquaculture industry use significant volumes of imported fishmeal, which is derived almost entirely from small oily fish caught in the southern oceans. Fishmeal is a major component of UK aquaculture feed, representing 35% (95,000 tonnes) of total usage and worth ~£95 million. There is also significant use of fishmeal in northern Europe (560,000 tonnes), continental Europe (245,000 tonnes) and Chile (600,000 tonnes). With strong demand for aquaculture feeds predicted in the coming years, the replacement of fishmeal with more sustainable alternatives that compete on a price and performance basis in aquaculture applications is a key priority to ensure a competitive UK aquaculture industry in the future.

The results

The Biosciences KTN helped a business-led consortium secure funding through the Technology Strategy Board 'Sustainable Protein Production' competition, as part of the Sustainable Agriculture and Food Innovation Platform (SAF-IP). Eminate Ltd, an innovative company formed as a spin out from the University of Nottingham in 2006, are leading the project, which will develop sustainable plant and algae-derived alternatives to fishmeal through the application of novel fermentation processes.

The project will take forward innovative work to process existing sources of plant material to improve bio-availability of nutrients for farmed fish applications. This technology is currently being used by consortium partners for the production of fermented soya products for the health food supplement sector. However, the technology has not yet been applied to the aquaculture industry. Following process optimisation using soya, the technology will be applied to UK grown cereal and legume crops to improve the nutritional profile of this material for

farmed fish production, for example by increasing the bio-availability of protein.

Algae will also be used to produce alternative feed formulations to fishmeal and can help to provide proteins and omega oils, such as EPA¹ and DHA², which have proven health benefits for cognitive function and cardiovascular health. The plant and algae material will be analysed to help optimise fish feed formulations using a range of assessment criteria (protein/fat content and quality, availability, cost of production) and ranked against nutritional profiles of classic fish food before feeding trial proof-of-concept work is taken forward using Zebra fish. Feeding trials on commercially farmed species, such as salmon or sea bass, will then be carried out by consortium partners, with customer validation provided by Skretting and Anglesey Aquaculture to ensure the feed and fish products meet industry standards.

¹ Eicosapentaenoic acid

² Docosahexaenoic acid

Project at a glance

- Fermentation of plant material has been used to enhance the bioavailability of proteins for use in the human food chain
- These fermentation techniques will be used to optimise plant protein sources for fish food applications, initially focussing on soya before translating the technology to UK-grown crops
- Incorporation of microalgae in formulations will provide essential omega-3 polyunsaturated fatty acids (e.g. EPA, DHA) necessary for health benefits associated with a diet rich in fish
- Return on investment of the £371K TSB grant could be > £10M in the UK alone within 3 years of the project end, with a predicted 10-15% share of the UK market for fish feed – (current price of fishmeal being £1,100/t and fishmeal replacement being targeted at a market entry price of £750/t)
- The products and technologies developed through the project could be applied to the international animal feed market, for example to develop meat and dairy products rich in omega-3 fatty acids

Replacement of fishmeal with plant-derived protein

- Fishmeal is a substantial component of feeds used by the aquaculture industry; sustainability of fish stocks destined for fishmeal production has been reported as a strategic concern by the FAO and UK Government
- Substitution of fishmeal by plant proteins has had limited success due to poor growth obtained in fish fed on diets high in plant-derived proteins
- A significant business opportunity exists to develop plant protein feeds that compete with fishmeal on a price and quality basis. This will also help to reduce pressure on global fish stocks

Using algae to improve the nutritional quality of vegetable-based fish feed

- Unlike terrestrial crops, algae can produce very long chain omega-3 polyunsaturated fatty acids (>C20), such as EPA and DHA, which provide the health benefits associated with a diet rich in oily fish
- Farmed fish obtain beneficial omega-3 fatty acids through fishmeal in their diet. Fishmeal is comprised mainly of small oily fish, which obtain the beneficial omega-3 oils from algae
- Incorporation of algae in fish feed formulation could help provide these important omega-3 oils, reducing the need for fishmeal and enhancing the sustainability of aquaculture



Eminate^{Ltd}



ANGLESEY AQUACULTURE LTD 



“The Biosciences KTN provided excellent advice and support during our application to the SAF-IP competition. The knowledge and experience gained during this process has helped secure funding through other TSB competitions, such as Nutrition for Life, helping accelerate new product development across a range of market sectors important to Eminate.”

Dr Sarah Gaunt, Research and Commercialisation Manager, Eminate

Project Details

Project partners:

Eminate Ltd; University of Liverpool; University of Highlands and Islands; Skretting; Anglesey Aquaculture

Project investment:

Consortium partners: £372,534
Technology Strategy Board: £371,296
Total project investment: £744,830

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