

INTERNATIONAL

**AQUA
FEED**

FISH FARMING TECHNOLOGY

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WELCOME

Although aquaculture has been practiced by different cultures around the world for thousands of years, arguably the modern form of aquaculture (typified by a fixed cage system located in a lake or close to an ocean shore) has really only been commercially practiced since the 1950s. Since then, the industry has followed a steep learning curve.

But, from its earliest days, the industry has come under attack from detractors and critics for its environmental impact and recurring issues such as escapes, sea lice infestation, waste build-up, etc. What needs to be better publicised as a counter to these critics is the amazing diligence, speed and responsiveness with which the aquaculture industry has recognised and sought to address these issues.

A steady stream of innovations has resulted from the efforts of highly educated and intelligent people in the industry and enterprising aquaculture companies willing to invest serious amounts of money to tackle and solve these issues.

A terrific example was recognised at AquaNor 2019, when Benchmark won the innovation award for its CleanTreat technology, which removes the medicines used in the delousing process and cleans and disinfects the water before returning it to the ocean. Similarly, nearly every aspect of industry is focused on improving productivity while protecting the environment.

Cage pen strength and integrity is constantly being improved with new materials and new technologies to minimise the impact of sea lice and reduce the possibilities for catastrophic escapes of farmed fish. RAS systems take this even further, as fish can be farmed at inland sites where escapes are impossible, and employ technology to efficiently clean, disinfect, and recycle water.

Recently, those who oppose aquaculture in favour of industrial marine fisheries were given a serious wake-up call after the



Vaughn Entwistle
Managing Editor, *International Aquafeed*

environmental activist group Greenpeace released a report publicising the fact that dumped fishing gear is the biggest plastic polluter in the oceans. More than 640,000 tonnes of nets, lines, pots and traps used in commercial fishing are dumped, abandoned and discarded in the world's oceans every year.

Worse still, is the fact that much of this plastic waste includes fishing nets which become damaged or entangled and then are cut free to drift the oceans. These so-called "ghost-nets" then entrap and kill millions of fish. Greenpeace stated that these nets and lines can "pose a threat to wildlife for years or decades, ensnaring everything from small fish and crustaceans to endangered turtles, seabirds and even whales."

Another shocking statistic was supplied by a recent study of the "great Pacific garbage patch", which is an area of plastic accumulation in the north Pacific estimated to contain 42,000 tonnes of megaplastics, of which 86 percent are fishing nets. Unfortunately, no region is safe from the scourge of plastic waste as discarded nets and fishing lines are carried by tides and currents over the world's oceans, including sensitive environments as far flung as coral reefs, island wildlife sanctuaries, and ocean regions at either pole that are pivotal to the marine food chain.

Perhaps, as an industry, aquaculture needs to become more vocal about its accomplishments to counter much of the misinformation that is being spread by the more sensationalist members of the world's media. In the two years that I have served as editor of this magazine, I have witnessed an industry that never shirks its responsibilities and is engaged in improving in every aspect of operations in order to feed the world's growing population, while simultaneously reducing its environmental impact. For these and many more reasons, I believe that aquaculture is an industry we can all be proud of.

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For the first time in history the consumption of farmed fish has exceeded that of wild-caught fish. What's more, aquaculture is expected to account for two-thirds of the fish that humans consume by the year 2030. The quickly increasing demand for fish has put more pressure on resources and sustainable practices among fisheries, thus requiring the use of both existing and new technologies.



Sam MacDonald
President, Deep Trekker

Aquaculture is a relatively young industry, decades behind that of livestock farming, leaving plenty of room for the adoption of new technology to foster continued advancement. At Deep Trekker, we pride ourselves on our constant innovation. As part of our mission to provide fisheries and aquaculture with the best technology possible, Deep Trekker has released the new DTG3 Navigator ROV.

Remotely operated vehicles (ROVs) have proven themselves to be incredibly useful in the aquaculture industry. Nets, mooring lines, and anchors can be inspected accurately and efficiently at a moment's notice, allowing users to regularly monitor for wear and tear. Stock health, including fish behaviour and feeding processes, can be easily observed on a consistent basis to ensure the wellbeing of your stock. With an ROV, operators can be constantly on top of the integrity of their underwater infrastructure and the health of their stock.

The DTG3 Navigator ROV is for the everyday underwater professional. An added precision thruster and advanced USBL positioning system make the Navigator Package an extremely advanced and maneuverable ROV with the same portability and durability Deep Trekker pilots are accustomed to.

Constructed with cast aluminium, anodised and epoxy-coated for

corrosion resistance, the unique spherical design has inherent strength. Combined with proprietary, no-maintenance thrusters, Deep Trekker's clean-sheet design and expert innovation ensure the system will last for years. The ROV is designed to grow with you, as industry-specific add-ons and attachments are made to be added to the machine as needed.

The added precision thruster at the rear of the vehicle enables users to move up and down without utilising the pitch function.

With the precision thruster engaged, pilots can make depth changes without any rotation of the ROV making it ideal for inspection and observation.

Arguably the most challenging part of operating an ROV is keeping track of your location underwater. The ultra-short baseline (USBL) system uses triangulation to indicate the position of the ROV. Wi-Fi enabled maps allow you to see where both the controller and the ROV are located on a detailed map. The USBL system simplifies navigation, allowing users to confidently determine where they are underwater.

Equipped with a 270-degree rotating, 4k UHD camera to capture high quality footage, the ROV dives up to 200 metres to allow for thorough inspection ensuring the integrity of aquaculture farms. Onboard batteries with up to eight hours of life provide fish farmers with a reliable tool to conduct regular inspections without incurring the cost of divers.

Future development relies on the industry's ability to optimise processes. By designing advanced and sophisticated underwater technologies, Deep Trekker is aiming to further the growth and achievements of the aquaculture industry. The DTG3 Navigator ROV provides users with cutting edge technology to maximize the success of their farm.



AQUATIC Health and Nutrition Asia 2020

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My editorial this month comes from Mexico where I have been attending many meetings including the 15th International Symposium on Aquaculture Nutrition held in Merida, Yucatan.

I was able to meet many old friends from Mexico and new contacts in this small but much focused scientific forum on a selection of specialised topics.

There were very interesting talks with many describing the approach of using novel feed ingredients from local sources such as marine algae, plant ingredients and relationships to health and nutrition. Some academics discussed the latest research concerning an old favourite of mine, Vitamin C and the ascorbic acid levels in diets and fish tissues with regard to health and physiological and metabolic status.

The meeting was organised by the local university with a good range of speakers from academic institutions in Mexico and some other Latin American countries. I was pleased to see molecular biology being employed in some studies on tilapia and shrimp for the assessment of the microbiome as well as talks concerning exotic fish species both freshwater and marine, temperate and tropical.

Of course, the nutrition and feeding of shrimp was well covered with attendees from a wide array of colleges and universities as well as technical personnel from farms. It was very encouraging to meet new generations of students and to see their interesting posters on display.

Whilst in Merida, I was grateful to be invited to a local tilapia farm that specialises in their intensive culture using



Professor Simon Davies
Nutrition Editor, International Aquafeed

a controlled biofloc system. I had a technical talk with the owner and manager and learned much about the process and feed being used to augment the natural ecological background nutrition and floc matrix at the heart of production.

My visit included a trip to Guadalajara for a few days and coincided with the national holiday to celebrate the revolution and Mexico's independence and sovereignty. In this city I made a

return visit to the established shrimp feed company Azteca and toured their facility, meeting the owners and staff.

I was given a warm welcome by the mill managers and their openness was much appreciated as we discussed many developments in the shrimp feed aquaculture sector and the growth of this market in Mexico and beyond. Look forward to a more detailed report and overview in a later issue. I was impressed by their continued growth and innovation since my last visit in 2018.

My second phase of the trip was to Costa Rica to attend WAS Latin American and Caribbean Chapter LACQUA 2019. This was to be a mix of technical and scientific talks, presentations and meetings within a trade show format, as is usual for this type of gathering. I was able also to meet with many colleagues and even former students of mine who are now quite global in their outlook and with very good careers. It was my first attendance to this specific chapter of WAS but I am a frequent visitor to the Aquaculture America and Aquaculture Europe meetings and these offer much to help see how the industry is bespoke to the regions as well as the generic aqua feed agenda. I will endeavour to make a more specific report on the meeting in the New Year.

This issue of International Aquafeed also has a great variety of stories, including one concerning AllTech's latest feed innovations, as well as an expert topic on Wreckfish, a under-utilised species that the DIVERSIFY project are hoping to raise awareness of for its potential in the sector.

Given the very poor weather in Europe and North America with floods and bushfires in Australia it was nice to be in a more benign environment and to appreciate the type of fish farming and shrimp production requirements in this warmer part of the world.

With Christmas upon us and New Year celebrations with a new decade fast approaching us, I extend my best wishes to the readership of my column and look forward to exciting technical and scientific developments in the 2020's. Season's Greetings.



Simon Davies and Kurt Servin visit a tilapia farm using a biofloc system for production near Merida, Mexico



Simon Davies tours the AZTECA feed company in Guadalajara Mexico specialising in advanced shrimp feeds



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THE BIG PICTURE

Alltech InDepth: Eindhoven, Netherlands, October 1-2, 2019. Whenever feed giant Alltech schedules an event, it is invariably a major production with very high levels of technical content, often at the very cutting edge, and the event at Eindhoven was no exception. See more on page 24



Dr Neil Auchterlonie

Feeding our growing population

This month I am writing my column whilst attending the FAO's International Symposium on Fisheries Sustainability in Rome. The focus of the symposium is "Strengthening the Science-Policy Nexus" and it runs over four days at the FAO Headquarters building. With over 700 delegates from around the world, there are many involved directly with fisheries industry, policy, management, and science in attendance.

The format for the event has been a series of keynote presentations leading a panel discussion and a Q&A session with the audience.

A common theme underpinning all the presentations and the discussions has been reference to the UN Sustainable Development Goals, and particularly SDG14, Life Below Water. Understandably, the aims of the SDGs are highly visible with the FAO, but it is interesting to see how much they are being woven increasingly into government strategies and scientific objectives. I know that many of the marine ingredient producers and the aquafeed companies are also aligning their work to the SDGs, recognising their importance to business sustainability.

The major message coming from the event relates to the importance of fisheries and aquaculture in providing aquatic food for the future growing human population. As we all know, working in the industry, aquatic protein is the most efficient to produce and this can be done with relative reductions in greenhouse gas emissions in a way that can support the mitigation of climate change impacts.

This is an immensely important message in this time when we are being inundated with media reports of the effects of global temperatures rising and the imperative to maintain that increase as low as may be possible. That link between producing more food from aquatic systems and relative decreases in climate change impact risk is strengthening over time, but there were other secondary and important messages also coming through in the event.

These related to the importance of fisheries in providing jobs, income, and thus poverty eradication, as well as the importance of micronutrients in seafood. The latter topic was fascinating and relates to much of what we know in IFFO about the micronutrient content of fishmeal and the reasons why it is such a good feed ingredient.

In the context of human nutrition, it appears that the richness in micronutrient supply via fish consumption, whether long chain omega-3 fatty acids, vitamins or minerals, all improve the bioavailability of micronutrients in vegetable-source foods, so they have an additional effect that goes beyond their own nutritional content.

Although aquaculture is increasingly being recognised as important in relation to food security, there are also more references to non-fed aquaculture as important, with fed aquaculture apparently not being afforded the same emphasis. It seems that this is result of some negative perceptions about fish feed development and ingredient supply, not least the production of fishmeal and fish oil which even in this forum is often misunderstood. There is much to be done in ensuring that the public message about the importance of fed aquaculture is heard around the world, otherwise the industry may lose out on what is a fantastic opportunity for future growth.

Dr Neil Auchterlonie is the Technical Director at IFFO. He has managed aquaculture and fisheries science programmes in both public and private sectors. Academically he holds a BSc in Marine and Freshwater Biology from Stirling University, a MSc in Applied Fish Biology from the University of Plymouth, and a PhD in Aquaculture (halibut physiology) from Stirling University.

Biorigin is recognised ISO 14001/2015

Biorigin is proud to announce that its three Brazilian production units are now ISO 14001/2015. Recently a team of auditors from the ABS-QE certifier analysed the company's environmental management practices.

The audit was ended without records of non-compliance and Biorigin received the recommendation which recognises the sustainable actions and goals promoted by the company and which contributes to the search for increasingly demanding customers and markets.

Biorigin is always following the most important demands and market trends in order to work on the art of creating natural and sustainable solutions which promote people and animals' health and well-being.

"Consumers seek healthy, natural alternatives that bring appeals for sustainability. In addition, they require transparency from the food and pet food industries and from the animal protein chain, checking product labels and animal production condition and their impact on environment", says Mario Steinmetz, Biorigin General Manager.

ISO 14001 is the international standard that specifies requirements for an effective environmental management system (EMS). It provides a framework that an organisation can follow, rather than establishing environmental performance requirements.

"We have built a solid path to demonstrate to our stakeholders that our ingredients, in addition to their natural origin, quality and technology, have important environmental added value to food and feed industries worldwide", adding Steinmetz.

SYLFEED consortium achieves new milestone as Atlantic salmon trial successfully demonstrates efficacy of novel alternative protein

Arbiom, an agricultural-biotechnology company developing solutions to convert wood into food, recently announced the success of a recently completed scientific study evaluating SylPro®, its high-quality alternative protein ingredient, for juvenile Atlantic salmon feed. The study, conducted by Matis Icelandic Food and Biotech R&D as part of the SYLFEED project, was designed to demonstrate the nutritional performance of Arbiom’s protein product (SylPro®) in comparison with conventional plant and animal protein sources.

“These findings indicate that SylPro can be used to replace fish meal or plant-based proteins in feed for juvenile Atlantic salmon, a crucial developmental stage, and deliver equivalent nutritional performance as conventional protein sources up to 20 percent inclusion level,” said Alexandra Leeper, PhD candidate from Matis.

In the study, Atlantic salmon feeds were formulated with Arbiom’s high-protein ingredient as a complement to or replacement for fishmeal and plant-based proteins at various inclusion rates. The study was designed to evaluate the product’s nutritional performance in terms of body weight gain as well as its effects on the gut microbiome, which researchers measured over the course of a five-week trial period.

“SylPro represents a scientifically-backed new protein source for aquaculture feed producers and farmers, which outperforms current commercial protein sources”, said Dr Jon Arnason, Senior Animal Nutritionist from Matis.

The study results showed no statistical difference in body weight gain for SylPro compared to the control diet up to the 20 percent inclusion level. Additionally, there were no differences in fish mortality across treatments.

These results support the results from previous trials evaluating SylPro for use in

hybrid striped bass.

“This represents another critical milestone in Arbiom’s path to commercialising the SylPro product as we continue to validate its efficacy across multiple animal feed applications,” said Marc Chevrel, CEO of Arbiom.

SylPro is produced from wood through Arbiom’s process, which integrates fractionation and bioconversion technologies to efficiently convert wood residues into fermentable substrates for micro-organism production through pre-treatment and fermentation processes. The final product is a dried yeast, which is nutritional protein source for use in aquafeed, and other animal feeds.

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Scottish Government pledges support for Women in Scottish Aquaculture

An initiative designed to promote diversity in aquaculture is set to benefit from funding and support from the Scottish Government, to help boost career opportunities for women in Scotland’s thriving seafood industry.

Mairi Gougeon, Minister for Rural Affairs and the Natural Environment, met with Women in Scottish Aquaculture (WiSA) at the Scottish Association for Marine Science before announcing a UK £20,000 investment commitment at the Association of Scottish Shellfish Growers conference on October 31st.

Combined with an additional £30,000 of industry sponsorship, the funding will support WiSA’s core aims: to encourage more women to enter the sector, provide a supportive network across

industry and academia, and support partners to harness the potential of women in aquaculture.

Funding from the Scottish Government will go towards creating an online platform to support the membership network, as well as supporting a mentoring programme which will be delivered in partnership with Skillfluence, an organisation which specialises in professional development in science.

Launched on International Women’s Day 2019, WiSA is a collaborative initiative and follows a SAIC (Scottish Aquaculture Innovation Centre) consultation of 200 people working in the sector. Nearly all (90%) of the respondents were keen to see a network of support for women working, or considering a career, in the industry and more than three quarters said they would be interested in joining the group.

WiSA membership is open to anyone, of any gender, studying or working in Scottish aquaculture. Many of Scotland’s major producers including Grieg Seafood, Cooke Aquaculture, the Scottish Salmon Company, Mowi, Loch Duart and Scottish Sea Farms have joined forces to pledge their support for this ground-breaking collaboration network.

Rural Affairs Minister Mairi Gougeon said, “It cannot be right that there are so few women working in Scottish aquaculture. In any professional industry it is important to nurture a workforce that is diverse, and that means having a healthy gender balance.

“Women in Scottish Aquaculture was developed in close collaboration with industry because there is a growing desire by all to break down the barriers stopping women from moving into in this thriving sector. The funding I am announcing today will help to kick-start this work. I hope it will lead to many more women considering a career in aquaculture.”

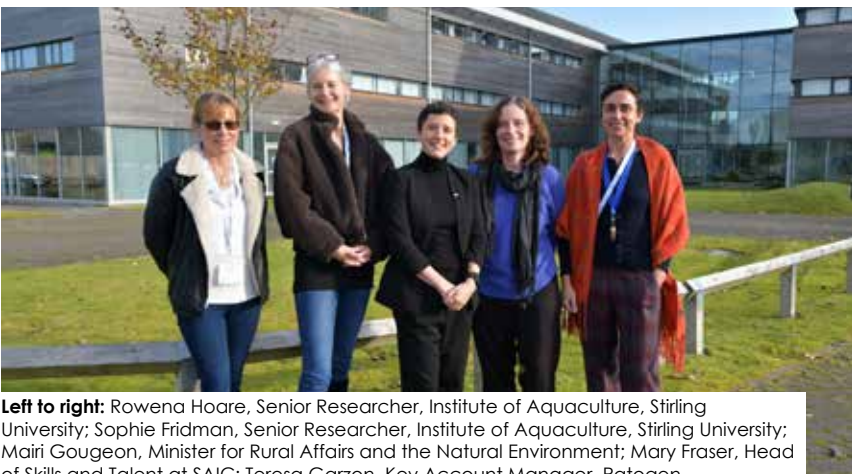
Heather Jones, CEO of SAIC, added, “I am passionate about supporting and promoting the role of women in Scottish aquaculture. I believe it is a vital step in helping the industry to grow. It’s been fantastic to secure financial support for this initiative from both the Scottish Government and the aquaculture industry in Scotland. The resources announced today will allow us to build capacity, confidence and capability amongst women working in Scottish aquaculture.

“Diversity matters - research shows that it can significantly impact business performance, with companies that commit to diverse leadership likely to be more successful than those who don’t.

Equality is a universal value that Scotland champions and SAIC is proud to be a founding member of the Women in Scottish Aquaculture network. We’re committed to delivering positive change through this initiative over the next five years.”



Left to right: Mairi Gougeon, Minister for Rural Affairs and the Natural Environment; Mary Fraser, Head of Skills and Talent at SAIC (Scottish Aquaculture Innovation Centre)



Left to right: Rowena Hoare, Senior Researcher, Institute of Aquaculture, Stirling University; Sophie Fridman, Senior Researcher, Institute of Aquaculture, Stirling University; Mairi Gougeon, Minister for Rural Affairs and the Natural Environment; Mary Fraser, Head of Skills and Talent at SAIC; Teresa Garzon, Key Account Manager, Patogen



Aker BioMarine's krill fishery receives an 'A' rating for the fifth year in a row

For the fifth year in a row, Aker BioMarine has received an 'A' rating from the Sustainable Fisheries Partnership (SFP), meaning its krill fishery is in "very good condition." SFP is an independent non-profit organisation that evaluates the sustainability of global fisheries. Each year, the SFP releases a Reduction Fisheries Sustainability Overview which analyses reduction fishery stocks worldwide.

According to the 2019 report, three percent of the total catch volume of the reduction fisheries in the analysis comes from stocks classified as "very good condition." As in the four previous editions of this report, this corresponds to a single fishery: Antarctic Southern Ocean Krill.



Matts Johansen



Runa Haug Khoury

"With a growing population, it has never been more important to make healthy food and nutrients available while also keeping our planet's ecosystem healthy," said Matts Johansen, CEO of Aker BioMarine.

"70 percent of the planet is covered by oceans, but only two percent of the food consumption and 0.5 percent of FDA approved pharmaceuticals comes from the oceans. As a unique and diverse system, the ocean plays a critical role in the world's future. And with a recent global shift away from meat, we are helping to save the footprint from food production on land."

The SFP 2019 reduction fisheries report looked at 26 reduction fishery stocks worldwide and showed that 88 percent of the catch comes from fisheries that are "reasonably well-managed." It also identified an increase of two percent in the volume of fish from fisheries that are considered "poorly managed."

"The important work of SFP leaves no doubt that we need a new kind of leadership at sea. We know that we need to harvest the oceans more. But we need to do so in a much more sustainable way," said Runa Haug Khoury, Director Sustainability, Aker BioMarine.

"Creating long-term worth and success in global fishery requires a business approach that values both opportunity but also the responsibility of harvesting of natural resources. At Aker BioMarine, we are proud of the SFP 'A' rating and will continue our efforts to inspire other fisheries worldwide."

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Global Aquaculture Awards 2020 open for entry

Categories for the 2020 Aquaculture Awards were announced on November 4th, allowing aquaculture companies from around the world plenty of time to prepare their entries and nominations before the March 9th, 2020 deadline.

The awards, which will be presented during the Aquaculture UK exhibition in Aviemore on May 20th, are designed to showcase the cutting-edge innovators and most exciting developments taking place in the world's fastest growing protein production sector. Following the success of the 2019 Aquaculture Awards which generated record numbers of entries from around the globe they will be open to international contenders from all aspects of this global sector.

"The 2019 awards generated widespread interest, attracting 78 entries from 16 countries. They also brought an international audience from across the aquaculture spectrum to the awards presentation ceremony in Scotland, helping to promote best practice in the industry," says Nigel Balmforth, Head of Publishing at 5m.

"The 2020 awards categories have been chosen to

highlight excellence across the sector, from the contribution of individuals just starting in the industry, to the impact made by established multi-nationals which have an ability to improve food security around the world. Following industry feedback, they will include four new categories," says event organiser Susan Tinch.

"We're currently inviting forward-thinking companies to sponsor the categories and have several category sponsorships still up for grabs," she adds.

Awards categories include Best Aquaculture Company, Finfish Farmer of the Year, Shellfish Farmer of the Year, Outstanding Contribution to the Industry, Environmental Impact Award, Aquaculture Supplier of the Year and Animal Welfare, to name a few.

Applications will be evaluated by a six-person panel of judges to be announced shortly who have been selected for their breadth of knowledge of the international aquaculture sector. They include well-known figures from industry and academia.

When examining the individual entries, the judges will consider the criteria identified for each category. Following consideration of all entries, the judging panel will identify shortlists for each category, from which the winners will be selected.

BioMar introduces authenticity DNA testing for marine ingredients

The testing platform, developed by Norway-based Orivo in collaboration with BioMar, is based on advanced DNA-technology. The test determines the species composition of marine ingredients with a high level of precision, able to detect the presence of even very small amounts of DNA.

BioMar believes that DNA-testing of marine ingredients in the aquaculture industry is a natural answer to the call from customers and stakeholders for improved transparency and traceability in seafood value chains.

BioMar realised already fifteen years ago that the industry could not grow at the expense of wild fish stocks. Since then, they have improved the sustainability profile of their sourced fisheries by supporting science-based certification schemes (IFFO RS, MSC, ASC, etc.) and

by developing alternative raw materials, such as vegetable protein and microalgae for marine omega-3s.

Supporting the development of DNA-testing of marine ingredients is therefore the next step in BioMar's commitment to responsible sourcing of marine raw materials.

"Reports of fraud in many of the world's largest seafood markets highlights the importance of accurate and reliable traceability data throughout the value chain. BioMar will now be able to genetically test whether the species composition in a sample of raw material matches the reported composition on the traceability certificate.

"BioMar has a great deal of trust in our suppliers and understands that both have a responsibility as stewards of the ocean. As such, we expect this new DNA-based test to play a crucial role in efforts focused on

building consumer and stakeholder trust", said Vidar Gundersen, Sustainability Director, BioMar Group.

After several years of dedicated R&D effort, the system has been thoroughly tested and optimised to produce reliable, accurate, and reproducible results. The test will be commercially available from January 1st, 2020.

"To have BioMar, one of the largest and most innovative aquaculture feed producers, join as our first client in this area has been key. We greatly appreciate the patience and faith they have shown during the development and testing stage of the technology. Their long-term commitment to this project is a sign that the service we are now providing is of value to the feed industry, and we hope this is just the beginning of a long and fruitful collaboration", says CEO Svein Erik Haugmo from Orivo.



Monaco Blue Initiative

Monaco

Launched in 2010 on the initiative of HSH Prince Albert II of Morocco with the goal to discuss and improve ocean sustainability for generations to come, International Aquafeed were invited to attend the latest meeting of the Monaco Blue Initiative. The tenth meeting discussed the importance of establishing marine protected areas to keep our oceans thriving



The AllTech Ideas Conference

Kentucky, USA

Our editorial team were very happy to have been invited to the 2019 AllTech Ideas Conference, where we discovered the latest in innovative feed technology through informative seminars and presentations





FISH FARMING TECHNOLOGY

Highlights 2019



Aquaculture Asia Conference

Bangkok, Thailand

Organised in conjunction with VIV, the Aquatic Asia Conference featured a variety of expert speakers from companies such as Bühler, Aker BioMarine, Phileo Lesaffre and Tanin Sevnica to name a few. Our own Editor-in-Chief, Professor Simon Davies of Harper Adams University, led the proceedings and held the slot as keynote speaker with his presentation on resiliency in shrimp



The DIVERSIFY Project

EU

We were extremely happy to team up with EU-funded project DIVERSIFY in 2019, to feature six exclusive articles in our magazine concerning a five-year study into the most sustainable fish species for fish farming



Les Poissons du Soleil

Balaruc les Bains, France

International Aquafeed were very happy to visit Les Poissons du Soleil and discover their state-of-the-art RAS facility, located in Balaruc les Bains, France



“International Aquafeed would like to thank all of our supporters in 2019 - and would like to wish all of our readers a happy and prosperous 2020”



The Aqua Feed Extrusion Conference

Bangkok, Thailand

International Aquafeed, in association with Dr Mian Riaz of Texas A&M University and VIV, proudly hosted the latest rendition of the Aqua Feed Extrusion Conference at VIV Asia, featuring speakers from a variety of international companies discussing the latest in extrusion principles and feed technologies



Aqua Nor

Trondheim, Norway

International Aquafeed attended Aqua Nor 2019 and spent a brilliant week discovering the latest in fish farming technology deep in the heart of Norway

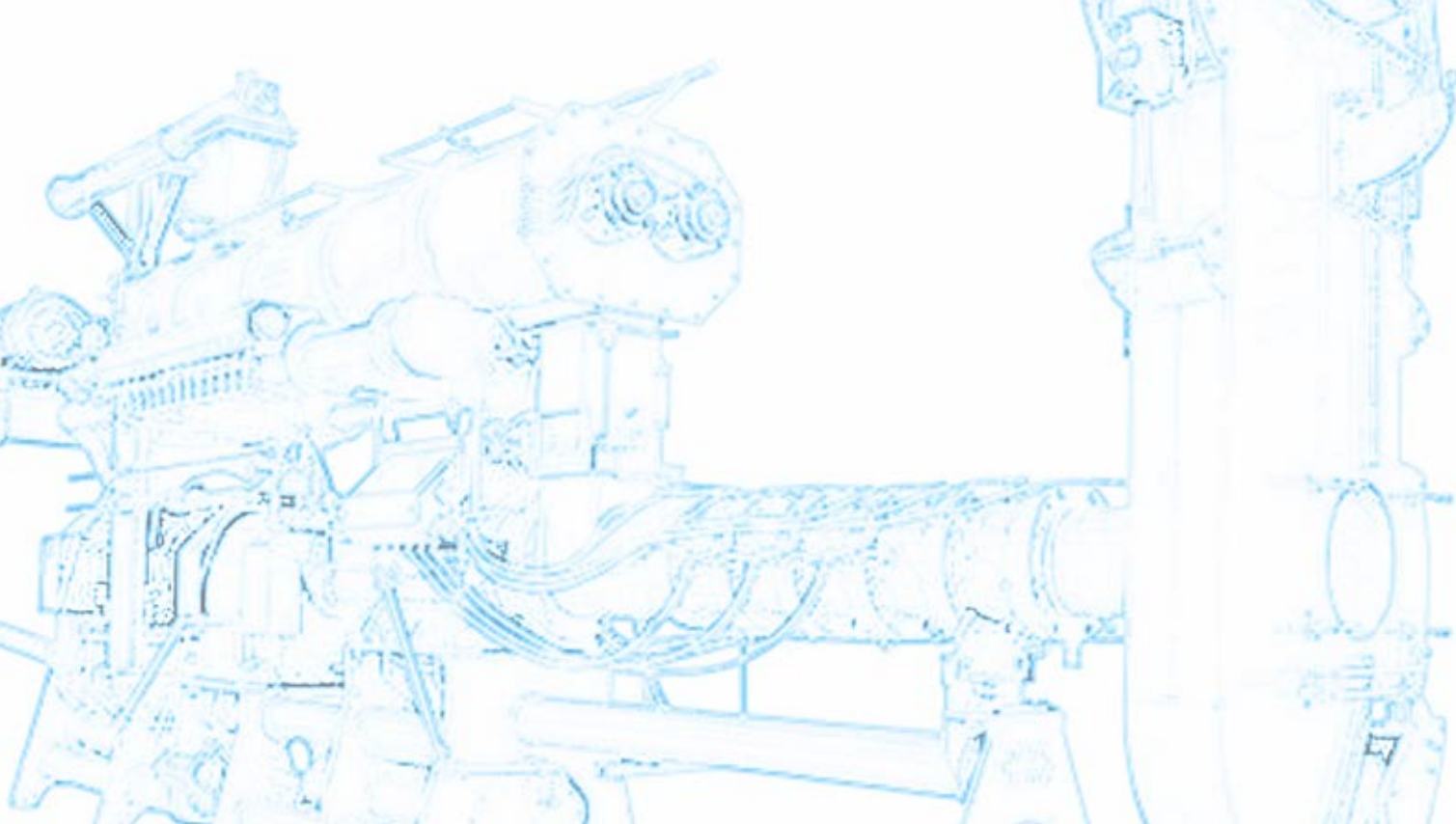


Aquafarm

Pordenone, Italy

Our team attended the third annual AquaFarm exhibition in Pordenone, Italy. We were also kindly invited to host and moderate various conference sessions during the event





Extru-Tech, Inc: Aquatic feed extrusion overview

Founded in 1985, Extru-Tech, Inc has grown into a diversified corporation that designs and builds extrusion processing equipment for a wide range of industries and applications, including the highly diverse aquatics feed industry.

Certainly, formulation changes, physical characteristics of aquatic feed and higher production rates have impacted the industry in recent years. Yet, Extru-Tech has adapted with new products and technology that simply can't be matched by lower-priced, imitation machines.

In 2016, Extru-Tech further enhanced its position in aquatic feed extrusion by hiring Dana Nelson, a renowned aquatics feed producer, as an Aquaculture Specialist. Unlike aquaculture specialists with competitive companies, Nelson offers more than 30 years of end user experience as one of three owner partners in Nelson & Son's, Inc, the original developers and producers of Silver Cup Feeds.

As Nelson is quick to remind customers, the aquatic feed industry entails a wide range of markets that demand everything from micro pellets and shrimp feeds to specialised feeds for recirculating aquaculture systems. Hence, where Extru-Tech really excels, he says, is with evolving new products, as well as difficult-to-produce and challenging aquatic products that simply can't be produced with lesser machines.

Realising that aquatic feed production is often a low-cost/low margin business, Extru-Tech has also developed a broad line of equipment to improve efficiency and lower production costs. Among them is the company's Maxxim Series high-capacity, single-screw extruders that are capable of 20-to-30 percent production rate increases over previous models with the same barrel diameter.

Aquatic feed manufacturers have also benefitted from Extru-

Tech's Advanced Feature Dryers, which offer faster, easier clean-out and maintenance, as well as the company's Advanced Density Technology, which counteracts the challenges associated with processing low-fat sinking aquatic diets.

One of the newest, most significant innovations from Extru-Tech is the Advanced Feature Knife, which self levels and self adjusts the knife to the face of the die as it wears, providing up to 10 times the previous life span. That translates into better "uptime" and "yield" performance, because the knife doesn't become dull over time, and less time lost during shut down to change knives.

Today, Extru-Tech continues to look to the future and evolving markets, not just by developing equipment to control cost of production, but in meeting increased quality requirements and the use of new ingredients.

That includes developing equipment and techniques to meet sustainability demands and the evolving transition from fish meal to novel ingredients, such as vegetable proteins, algae meals, insect meal and single-cell proteins.

Of course, all of these innovative ingredients behave much differently in an extruder, which means aquatic feed manufacturers need more than quality equipment. They also need the expertise of a company like Extru-Tech behind it ... now and well into the future.

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The BioFish solution by Biolan:

Certified technological innovation to guarantee the quality and safety of seafood

by Biolan, Spain



The impact of technological innovation and modernisation in the productive and extractive sectors to achieve the levels of competitiveness and sustainability that the global market requires, is undeniable.

Nowadays, in order to be competitive, it is not enough to achieve maximum productivity, unthinkable cost savings, or efficiency levels never seen before. The key to competitiveness in the extractive fishing sector, aquaculture or seafood canning industry, as in any other field, lies fundamentally in the valorisation of the quality and guarantees of the product by the final customer, in order to prioritise it over the huge offers that arrive every day.

The challenge must be to achieve solid and long-term customer loyalty. And this, in a global market and focused to reach important shares in international markets, requires us to ensure that the product arrives in optimum conditions and complies with the legal requirements of each destination.

And it is in the seafood quality and safety sector where so many factors influence and condition a satisfactory final result, which forces the industry to implement procedures that facilitate optimal and efficient control of the resulting product. It is in this field that technological innovation must play a fundamental role, trying to respond to the needs in the productive or extractive fishing systems.

In this sense, the technology suppliers must guarantee that the innovative solutions comply with the reliability and precision required by the operational process.

Biolan

Biolan Microbiosensores, a Basque biotechnology company, as technological supplier to the food industry for more than ten years, from the beginning has been aware of the difficulty to provide technological products with an absolute guarantee.

As a world leader in the application of biosensor technology to the monitoring of food quality and safety, Biolan dedicates great efforts to accredit the precision, reliability and repeatability of its based-on biosensors for quantifying analyses in food.

A biosensor is based on a biological detection element coupled to a physical-chemical transducer that converts the biological

signal, originated by the interaction between this detection element and the analyte, into a quantitative result. Biolan Biosensors combine the high specificity and selectivity of specific enzymes with an amperometric transduction of the signal, easily detectable and quantifiable.

Based on this biosensing technology, Biolan has progressively developed new applications for the food industry, such as the



BioFish line that offers biosensors for the quantification of histamine in fish and sulphite in crustaceans, in a precise, fast and simple way, at any point in the production, processing or commercialisation chain.

Histamine, the best indicator of fish freshness and quality

Histamine, whose maximum levels are regulated by regulatory statements, has become the key parameter for the determination of freshness and quality of fish, being the cause of food poisoning similar to those produced by food allergens.

Histamine, that continues being the protagonist of several episodes of food safety alarm, is considered the main indicator of deterioration in some fishing species. The histamine content in freshly caught fish is so low it practically doesn't exist as a traceable substance.

After the fish's death, microorganisms begin to transform the free histidine present in fish into histamine. The bacteria related with post-capture handling join to the already-present bacterial population in the fish, so there is an exponential growth of bacteria while the freshness is continually reducing, and as result the histamine concentrations could exceed 2,000ppm (2 grs/kg) in 24 hours at room temperature.

High concentrations of histamine in foods, particularly levels between 200-500 ppm, can cause intoxication in consumers, appearing through symptoms of undesirable physiological effects. For this reason, the analysis of histamine content in food is important for food safety, through having its levels regulated by legislation.

The European Community (EC No 2073/2005) establishes



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a maximum content between 100 and 200 ppm of histamine in fish. Being a thermostable molecule, it remains in the fish after undergoing heat treatments. Therefore, histamine is a very effective marker to ensure food safety and quality in fish.

Until recently, only complex analytical techniques were used for the detection of histamine such as high-precision liquid chromatography HPLC, ELISA-type immunoassays, and enzymatic methods, all carried out mainly in specialised laboratories.

However, more than four years ago, Biolan revolutionised the sector with the launch of its own differentiated method, BioFish 300 HIS, which allows the quantification of histamine in fish and fish derivative products in a precise, simple and fast way. Its low cost and the possibility of real time analysis in just two minutes, without pre-treatment of the sample, means that it can be manipulated by unqualified personnel, enabling the fish industry to carry out its own controls.

But Biolan has gone further, and recently launched BioFish 700 HIS, a portable solution for even faster and more accurate analysis at any fish processing point, providing an integral quality control, based on disposable screen-printed electrodes, which are already calibrated and ready to use in one single step.

Integral monitoring of sulphite in crustaceans, a guarantee of maximum quality

Sulphite is used as a food additive because of its antioxidant and antimicrobial properties that help preserve the quality and appearance of foods (crustaceans, wine, beer, meat products, dried fruits and vegetables). As such, it is included in European Commission Regulation (EU) 1129/2011 (amending EC 1333/2008), which lists the authorised food additives and establishes the maximum levels of SO₂ per food category (mg/kg or mg/L).

However, the already proven hypersensitivity to sulphites of many consumers, especially people with respiratory problems which can trigger respiratory alterations and skin reactions, has led to them being considered food allergens by the main international organisations that ensure food safety: the European Commission in accordance with Directive 2000/12/EC; Codex Alimentarius Commission; Food and Drug Administration FDA-USA 1986.

Consequently, the concentration of sulphite must appear on the labelling of food, complying with EU Regulation 1169/2011, on the information and labelling that the food industry must comply with in relation to allergens. Similar regulations on food allergen labelling and consumer protection apply in the US. (FDA, Public Law 108-282 of 2004) or Canada (Food Allergen Labeling Regulations in the Canada Gazette, Part II, 2011).

In the crustacean industry, sulphite is added to prevent melanosis after capture of the crustaceans and throughout the production and handling process. Melanosis is an enzymatic oxidation reaction that is triggered by the death of the animal and although it does not affect the taste of the food or the health of the consumer, it does have a drastic impact on the visual acceptability of the product and, therefore, on the perceived value in the market.

European regulation establishes the maximum level of sulphites (E-220 - E-228) in fresh, frozen, deep-frozen and cephalopod crustaceans at 150mg/kg to be consumed as food. Therefore, the industry must monitor the concentration of sulphite throughout the production process to comply with existing regulations. In addition, sulphite levels higher than 10mg/kg or 10 mg/L must be declared on the label to inform about the risks to a potential hypersensitive consumer.



Compliance with all this legislation represents yet another challenge for the crustacean production industry, which must implement internal monitoring and traceability procedures for sulphite content throughout the production chain, usually integrated into their HACCP (Hazard Analysis and Critical Control Points) systems, and consequently they must be simple, fast and obviously precise.

Currently the most used method for the determination of sulphite is called Monier-Williams (AOAC 962.16). The length of time needed for analysis is extensive and the accuracy is questioned by issuing false negatives, which is also a concurrent incidence using other methods. That is why Biolan developed BioFish SUL to quantify sulphite in crustaceans, in a fast, precise and simple way, both at laboratory level, with a table top biosensor (BioFish SUL 300), and in water tanks where shrimp are treated by means of a portable biosensor (BioFish SUL 700), based on disposable and pre-calibrated screen-printed biotests. In this way, an integral control of the sulphite in the whole process is facilitated, even in the most critical points, avoiding the excessive presence of sulphite in the different stages of the shrimp processing.


Biolan biosensing technology certified at the highest level

In addition to the multiple external validations that Biolan carries out for each of its products, the company's strategy is to achieve maximum and worldwide recognition of its technology, and this has already been achieved on two occasions.

In 2016, BioFish 300 HISTAMINA obtained the AOAC® Performance Tested SM certification, license 05160, from the AOAC Research Institute, and in 2018 BioFish 300 SUL obtained also the AOAC® certification, license 031802, for the detection of sulphite in shrimp in the ranges 30-150 and 50-300mg/kg, established in current legislation. Both certifications show that BIOLAN biosensors have an accurate sensitivity comparable to official reference methods.

Therefore, the BioFish method, both in the 300 series for laboratories, and in the 700 series as portable field equipment, provide speed and precision in the process of ensuring food safety, without using chemical reagents and therefore, without generating any residue.

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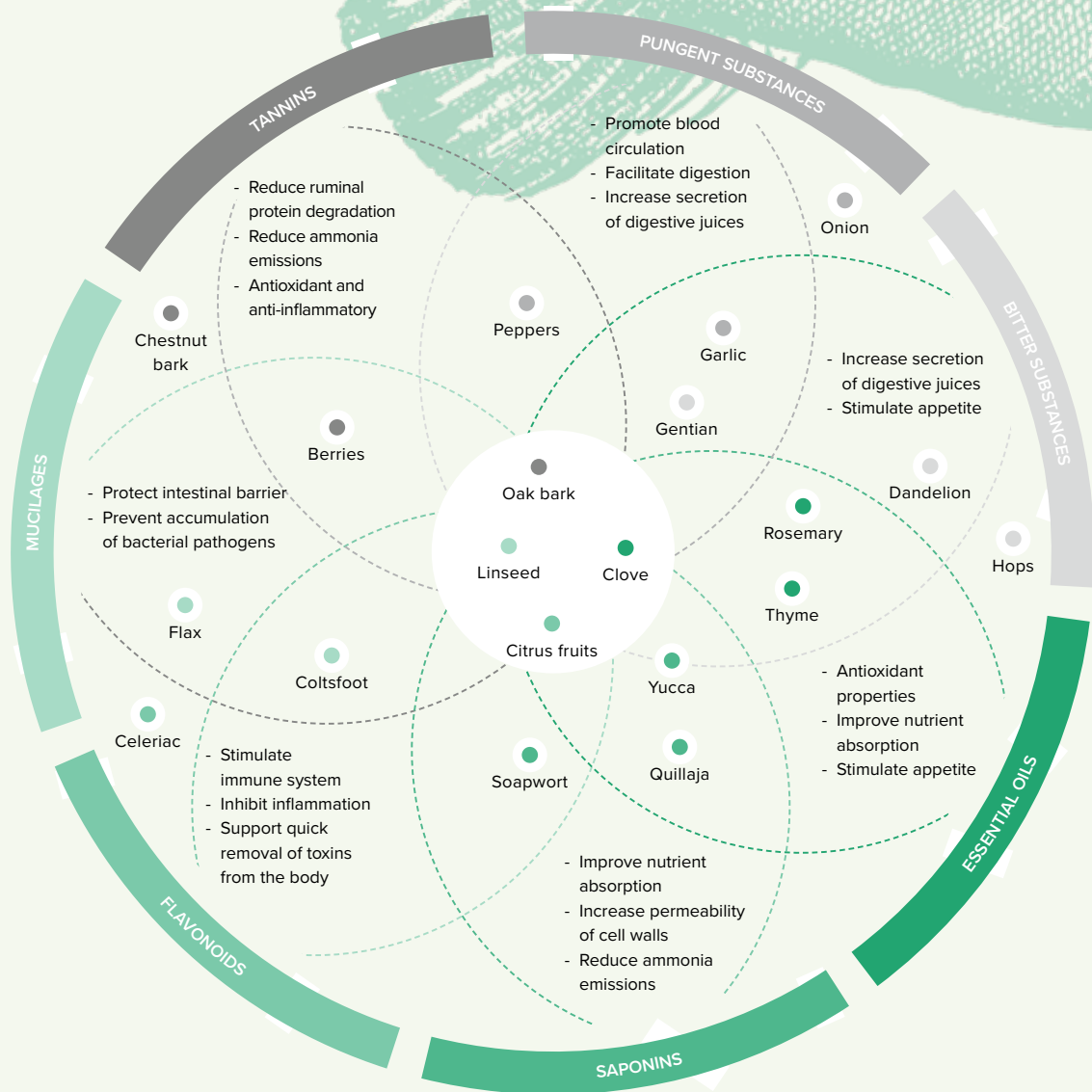
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Phytogenics in aqua: Looking for the ‘big fish’?



by Dr. Alex Makol, Dr Anja Keiner and Dr Andreas Mueller, Delacon, Austria

As a direct consequence of the stagnation of capture fisheries and globally increasing fish consumption, aquaculture represents one of the fastest-growing sectors in food production. However, the limitation of marine raw materials in aquaculture diets and their replacement by more sustainable protein and lipid sources of terrestrial origin, in some cases, is associated with negative consequences on the metabolism and immune system of aquaculture species and may slow down the development of the sector.

The global trend to ban antibiotic growth promoters, for fear of the development of resistant bacterial strains, and to protect

consumers' health, has driven the sector to invest into research in natural alternatives instead.

Plant substances on the rise

Phytogenic feed additives (PFAs), commonly defined as plant-based feed additives or botanicals, represent a group of natural substances used in animal nutrition. These substances are derived from herbs, spices, other plants and their extracts consisting of highly active plant substances and encompass much more than essential oils: they include spicy or bitter substances, saponins, flavonoids, mucilages or tannins.

During the last two decades, research on phytogenics as potential functional ingredients has increased, and with it, their commercial use in the animal production sector. However, a deeper understanding of the mode of action of the bioactive

compounds of phytochemicals in fish and shellfish is key to improve their use in aquaculture.

Some of the bioactive phytochemical compounds have been proven to stimulate digestive enzymes production, support liver function, modulate gut microbiota imbalances, and have potent antioxidant and anti-inflammatory properties.

Fortunately, during the last years, scientists and companies have done a lot of research to elucidate, how specific phytochemicals may improve nutrient uptake and/or disease and stress resistance in fish and shellfish as an important basis for optimal sector expansion.

The understanding of the mode of action of newly formulated complex phytochemical mixtures (blends) will help the aquaculture sector to use available phytochemicals properly, to explore synergies and antagonisms among bioactive compounds and to clarify interactions with other feed ingredients. These facts will additionally help the aquaculture sector to improve its production performance.

Growth performance effects

Growth performance is the most frequently used parameter to determine adequate production management, and it may be affected by different factors, like nutrition, environment, pathogens or handling. Maintaining an optimum growth rate during stressful situations or even promoting it under normal conditions is one of the main demands in the sector.

Specific phytochemicals have been demonstrated to promote growth performance and feed efficiency in several fish and shellfish species. For example, Aloe vera (*Aloe barbadensis Miller*) extract improved growth performance in common carp (*Cyprinus carpio*) when fed for eight weeks.

Extracts of garlic (*Allium sativum*), oregano (*Origanum heracleoticum*), ginseng, quillaja (*Quillaja saponaria*), mentha (*Mentha piperita*) and sweet basil (*Ocimum basilicum*) promoted growth performance of Nile tilapia (*Oreochromis niloticus*) in several trials.

Similarly, for channel catfish (*Ictalurus punctatus*), growth performance and feed efficiency were enhanced, when fish were fed with oregano oil. These benefits could be associated with a positive effect on the fish microbiota composition, derived from the well-described antimicrobial properties of oregano. Garlic and onion (*Allium cepa*) extracts supported growth in European sea bass (*Dicentrarchus labrax*) and in the case of Whiteleg shrimp (*Litopenaeus vannamei*), several phytochemical substances, like yucca (*Yucca schidigera*), quillaja, ginger (*Zingiber officinale*), curcuma (*Curcuma longa*) and astragalus (*Astragalus membranaceus*) promoted growth performance.

The potential mode of action of the above mentioned individual phytochemicals, in general, has been associated with improved feed palatability, promoted digestive enzyme secretion, enhanced nutrient uptake and balancing effects on the intestinal microbiota. It is interesting to remark that the effect of phytochemicals is directly related to the fish species, the extraction process and to their bioavailability of actives rather than to the inclusion rate.

Supporting resilience

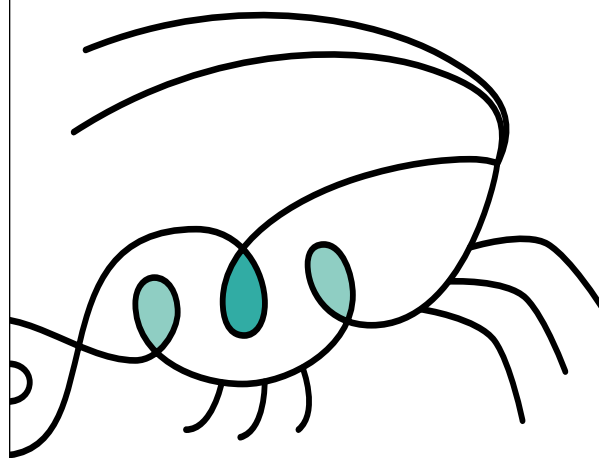
An optimal immune function of cultured fish and shellfish is a main determinant to protect them against infections with pathogens. Several studies have been addressed to determine how phytochemicals may boost the innate and/or adaptive immune system when supplemented to cultured fish and shellfish. In this context, garlic is the most studied phytochemical in terms of

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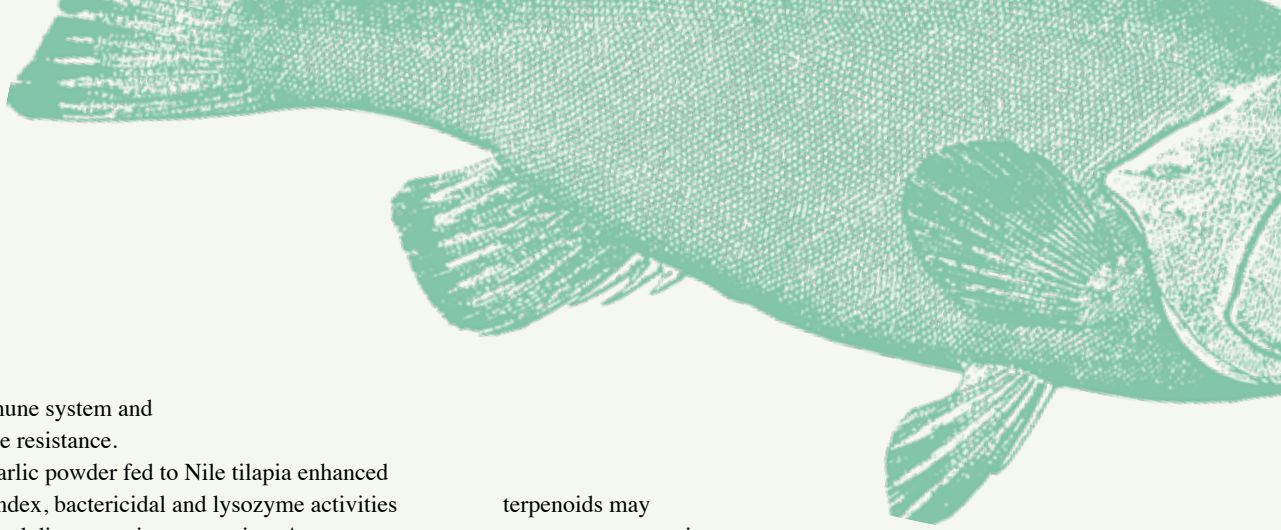
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boosting the immune system and increasing disease resistance.

For example, garlic powder fed to Nile tilapia enhanced phagocytic fish index, bactericidal and lysozyme activities as well as increased disease resistance against *Aeromonas hydrophila*.

Similarly, rainbow trout (*Oncorhynchus mykiss*) fed with garlic extract showed enhanced phagocytic activity, respiratory burst, lysozyme activity and, consequently, reduced fish mortality when challenged with *Aeromonas hydrophila*.

Recently has been proven that a mixture of garlic oil and labiatae plant extracts supplemented for nine weeks enhanced disease resistance and immune system response, promoted a healthier microbiome and reduced cortisol levels in European sea bass fed low fish meal and fish oil diets.

Indeed, oregano, ginger and rosemary (*Rosmarinus officinalis*) have shown to immunomodulate Mozambique tilapia (*O. mossambicus*) and European sea bass response. Turmeric oil and *Gynura bicolor* reduced mortality of whiteleg shrimp infected with *V. harveyi*, *V. alginolyticus* and white spot syndrome virus (WSSV), partially due to their enhancing effects on lysozyme, prophenoloxidase (proPO) and superoxide dismutase (SOD) activity.

Further, it seems that nutritional and environmental factors considerably influence the gut microbiome. The composition of the diet, including plant-derived actives, thus represents a crucial factor, hence being responsible for the modification of bacterial populations.

In this context, phytochemicals may modulate gut microbiota by enhancing the proliferation of lactic acid bacteria (LAB) like *Lactobacillus* and decrease the presence of potentially pathogenic bacteria. By the way, phytochemicals have been shown to unroll a higher activity against pathogenic bacteria than against commensal microbiota.

There are probably different mechanisms underlying this modulation, including direct and specific antimicrobial effect against specific bacterial species, or a quorum sensing inhibiting effect. Direct antimicrobial effects of different phytochemicals against specific pathogens have been demonstrated in different *in vitro* assays based on the Minimum Inhibitory Concentration (MIC) capacity of the phytochemical.

However, it is important to remark that results obtained in MIC assays differ between bacterial strains. Depending on the extraction method for the phytochemicals, differences in MIC may occur due to potential synergies among main actives and trace compounds contained in specific extracts.

For example, different extracts derived from eucalyptus (*Eucalyptus globulus*), oregano, and cinnamon (*Cinnamomum verum*) have been very effective against several fish pathogens like *S. iniae*, *A. hydrophila*, *Photobacterium damsela subsp. damsela* and *V. parahaemolyticus*. Phytochemicals also affect bacterial quorum sensing by reducing biofilm formation and by suppressing bacterial toxin production, which in the end, will inhibit or reduce the incidence of the disease outbreak.

Several plant extracts, like phenolics, flavonoids, alkaloids, and

terpenoids may act as quorum sensing inhibitors via different mechanisms, as the inhibition of N-acyl-homoserine lactones (AHL) synthesis, altering transport or secretion mechanisms, the binding and storage of AHLs, or the antagonistic actions or inhibition of targets downstream of AHL receptor binding.

Stress-reducing effects

Stress during aquaculture production is implicated by the production procedure (transport, stocking, grading or sampling) and can be reduced to a minimum by proper production management.

Stress directly results in reduced feed intake, a lower performance rate and higher susceptibility to disease outbreaks due to a down-regulation of the immune system and alterations in fish physiology, affecting the metabolism as well. Some- even when controlled - production practices (e.g., handling) mean stress for the cultured fish and require the use of anesthetics.

However, sometimes, the application of the anesthetic itself may act as a stressor. Recently, specific phytochemicals per se have attracted attention, acting as anesthetics. Concomitantly to anesthetic effects, phytochemicals come along with numerous of the above-mentioned beneficial aspects like antioxidant function, anti-microbial effects and stress-reducing properties. The most studied phytochemical anesthetic is clove oil which effective anesthetic concentration depends on the target fish species.

Interestingly, other phytochemicals, like Lemon verbena (*Aloysia triphylla*), Eucalyptus (*Eucalyptus sp.*), *Lippia alba*, clove basil (*Ocimum gratissimum*) and garlic have been shown to act as stress relievers by reducing cortisol levels in Nile tilapia, European sea bass and South-American catfish (*R. quelen*). Though the route of application is important for the desired effects. Whereas phytochemicals for sedation during transport and handling are applied in bath, general stress-reducing effects can be achieved by supplementing phytochemicals into the diets.

Conclusions

Phytochemicals can modulate physiological functions and intestinal microbiota, showing a clear potential for enhancing growth performance, and for improving disease and stress resistance in different cultured fish and shellfish species. However, there is still little knowledge about the mode of action of several of their bioactive compounds, possible interactions and synergies among them, as well as the most appropriate form of administration.

Consequently, further research is necessary to properly identify the most suitable phytochemicals and blends that are tailored to the current challenges in the aquaculture production sector. Understanding the phytochemicals' mode of action in detail represents a crucial tool in the development of new, well formulated, effective products.

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The future of healthy and profitable aquaculture

by Vaughn Entwistle, Managing Editor, International Aquafeed

Alltech InDepth: Eindhoven, Netherlands, October 1-2, 2019

Whenever feed giant Alltech schedules an event, it is invariably a major production with very high levels of technical content, often at the very cutting edge, and the event at Eindhoven was no exception.

THE PLENARY SPEAKERS

Doctor Mark Lyons PhD

AllTech President and CEO set the conference tone with a message of positivity and hope. His opening slide simply stated, “We are not doomed,” echoing the same theme that was iterated at the Alltech Ideas 2019 Planet of Plenty conference back in May 2019.

Dr Lyon’s take home message was the same as in that earlier conference: Human beings are immensely resourceful. Despite the challenges of population growth and climate crisis, we are not doomed if we focus on sustainability and collaboration.

The United Nations Food and Agriculture Organisation (FAO) estimates that we will need to increase food production by 25-to-70 percent to feed a projected population possibly exceeding eight to nine billion by 2050. Given these numbers with the additional complication of Global Heating, the challenges look daunting.

However, Dr Lyons’ belief is that the technologies that will create the future are already in our hands, and by bringing together highly skilled individuals, we can leverage the collective genius of the group and accomplish amazing things.

Alltech has backed up this philosophy with actions, as it has invested massively in research while also establishing research alliances with companies all over the world. Alltech has also been able to leap-frog its technology by acquiring eighteen businesses within six years.

In 2016, Alltech acquired Coppens International, a leading international aquatic feed solutions company in the Netherlands. At the time, Coppens International’s specialties included temperate and tropical marine and freshwater diets for a variety of juvenile and adult species.

Dr Albert Tacon

Next up was aquaculture nutritionist Dr Albert Tacon, who echoed Mark Lyon’s message of positivity by introducing the Hawaiian phrase “A ‘ohe hana nui ke alu’ ia” which translates



into English as “No task is too big when done together.”

Dr Tacon (who is based in Hawaii) began with his observation that global aquaculture has already exceeded the output of capture fisheries. He predicted that, because most coastal waters are publicly owned, the future of aquaculture will involve a move to the deep oceans and onto the land in the form of RAS farming.

He followed with a breakdown of the major species being farmed around the world and noted that the majority of fish currently produced globally are freshwater species. He predicts that shrimp will be produced in large tank systems covered by plastic for biosecurity. He also noted that, despite the rise of aquaculture in the West in recent times, Asia still produces 91 percent of farmed fish/seafood.

Dr Tacon sees the rise of aquaculture as a solution to two of the most pressing needs the planet currently faces: the famine crisis and the obesity crisis. He pointed out that consumers in Asian countries such as Japan, consume a great deal of fish and seafood in their diet and consequently have high longevity rates.

By contrast, consumers in western countries, such as Europe (apart from Norway and Spain), South America and North America, have low fish consumption rates and much higher incidence of obesity with correspondingly shorter life spans.

Gorian Nikolik

The financial aspects of aquaculture were addressed by the next speaker, Gorian Nikolik, Senior Industry Analyst, Food & Agribusiness Research & Advisory, Rabobank Industrial.

Mr Nikolik spoke about investment in key aquaculture value chains. Although salmon farming is the most technologically advanced form of aquaculture as practiced in western countries, it is still dwarfed by aquaculture practiced in Asian countries such as China. From an economic perspective, Mr Nikolik noted that aquaculture outperforms every other agricultural sector in terms of percent gross margin.

Nikolik sees a much higher growth in RAS aquaculture for the future. Shrimp will also gain in precedence, although the shrimp sector is more greatly affected by disease cycles than finned fish aquaculture. Due to domestic demand for shrimp within the shrimp-growing countries, many countries have turned from shrimp-producers into shrimp importers.

Although Thailand was once the biggest supplier of shrimp to North America, India has now overtaken it while China has overtaken everyone as the largest shrimp importer.

Offshore fish farming and RAS will be the next big players in the aquaculture market, and feed manufacturers will need to produce special feeds for those applications. Mr Nikolik spoke about how Rabobank has continued to support aquaculture even in cases such as Chilean fish farming, which was wiped out by



disease once, and then a second time.

Despite this the bank stood by the farmers and now the industry has returned to profitability. He explained how future trends can sometimes be unpredictable and difficult to predict. A German movie that portrayed fish farms growing Pangasius led to a decline in the consumption of that fishing.

An emerging business model is the rise of aquaculture in sub-Saharan Africa (especially Egypt) which are now doing a great job of supplying fish to the rest of Africa. He also sees Brazil as potentially the next South American aquaculture powerhouse due to low cost feed supply.

In more future trends, he believes that biocides, vaccines and other alternatives to antibiotics will be a game-changing technology. Finally, China will need to modernise its aquaculture industry much as the US and Europe has already done.

Dr Philip Lyons

Mark Lyon's message of progress through research was echoed by Dr Philip Lyons, who spoke about building an innovative research platform to meet the needs of a fast-changing industry.

Dr Lyons spoke about the All-Coppens Research Centre. Originally developed by Coppens International, when the company was acquired by Alltech the centre was fully refurbished by Alltech into a centre of excellence. The centre works with many fish species, with a special focus on trout, sturgeon, African catfish, eels, carp, tilapia and salmon.

He described how applied research produces rapidly applicable results. This research has facilitated the evolution of industrial fish feeds. In the past there was a focus by nutritionists on protein, wheat, fat and fishmeal.

At the present there is a focus on digestible protein, digestible energy, balanced AA profile, and DHA and EPA. Dr Lyons predicts that in the future there will be a focus on digestible and balanced AA profile, digestible carbohydrates, net

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First Alltech Inventor Prize

But not just high-tech solutions provided the focus for the morning plenary session. A terrific example was provided by the winner of the Alltech Inventor Prize, a programme based on crowd-sourcing ideas that could improve all areas of the aquaculture industry – from the hatchery to marketing.

The inaugural invention prize featured Highly Commended runners up and a Winner:

Highly Commended: Dr Deer Chanpipatkul (Thaiva Lab Co Ltd) for his solution involving the potential use of green Lipped Mussel powder (EGSMP) to improve the health and yield of aquaculture grown seafood.

Highly Commended: Bert Meijer ng Topsy Baits, from the Netherlands, for its solution of low temperature dehydration of polychaetes to preserve nutrition and enable lower cost global transportation.

Winner: Zoran Tepic, Ribnjak Janj d.o.o., Tropic Ribarstvo for the on-farm peracetic acid dispenser which treats fish with the optimum concentration off solution over a fixed duration by continual dosing using Evangelista Torricelli’s formula. Tropic Ribarstvo is a privately-owned fish farm in Bosnia and Herzegovina fish farm. They won for their low-tech, but highly effective invention – a peracetic acid dispenser for rainbow trout. Tropic Ribarstvo received its prize, comprising EUR

€2,000 (US \$2,183) worth of Alltech Coppens feed and the support of its innovation team to help develop the idea for the aquaculture industry.

As Alltech Coppens CEO Patrick Charlton explained, “Traditionally, the flow in the fish tank is stopped and the peracetic acid is manually applied to the water – this can cause additional stress on the fish and uneven distribution of the therapeutic. This invention is an extremely efficient method of treating fish in a way that ensures safe and stable dosing while minimising stress to fish stock during the process.”

The conference programs

The morning Plenary Sessions were followed by separate sessions for Finfish and Shrimp.

Factory and Research Centre visit

The next day, Wednesday October 2nd, delegates were driven to Germany, where they were able to tour the Alltech feed factory. This vast, modern plant is largely automated and produces a wide variety of feeds for both farmed and ornamental fish.

The day concluded with a tour of the Alltech Coppens research facility which has both RAS systems and outdoor ponds and raceways. The two-day event was informative and impressive in content and scope.

In all, the conferences were attended by more than 200 delegates from 42 countries. I personally learned a lot and hope to attend the next Alltech Ideas conference in Kentucky in 2020.



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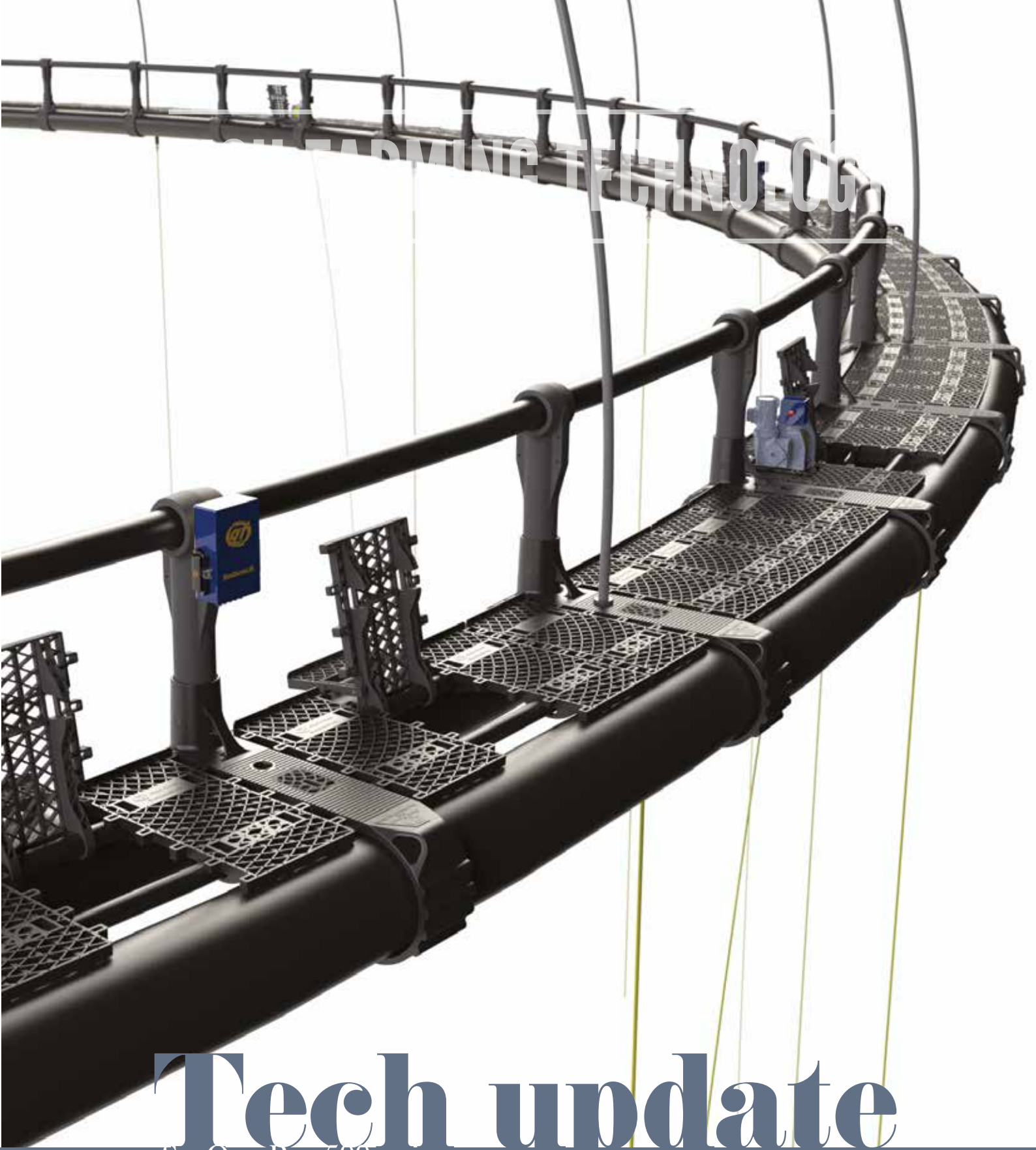
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Tech update

SeaQurePen 500

Created with the goal of establishing a fully integrated pen system for high energy sights, Gael Force Group's SeaQurePen is a resilient and evolutionary pen system that significantly lowers farming costs. The SeaQurePen is a result of extensive collaborative research and in-house expertise.

The I Beam-style gusset ensures superior holding power and the hinged service deck enables farms to have safe and easy access to subsurface utilities. The pen is available in sizes ranging from 120-200m in circumference and is low maintenance, long life.

www.gaelforceaquaculture.com



Solving the newest old problems in RAS technology

by Landing Aquaculture BV, The Netherlands

“The RAS sector is currently experiencing an unprecedented boom”

The RAS sector is currently experiencing an unprecedented boom. We are observing the numbers of large RAS installations growing each year, some at scales thought not possible a decade ago. With increased scale, the size of the risks and technical challenges has also grown.

The Jevon's paradox can be applied to RAS. The paradox postulates that increasing the efficiency of using a resource leads to an increase in the demand for such resource. In the end, the net use of the resource grows. With RAS, significant savings in water use have opened the map for suitable places for fish farming.

Peri-urban areas, rough coastlines and regions with limited water sources are increasingly attractive to build fish farms. Other areas with plenty of water available? Those are good for building even larger fish farms! In other words, being able to reuse more water is allowing us to build even larger farms that, due to their sheer size, will still use vast amounts of water.

Having a good source of water with excellent quality is as important as ever. In the past, water availability used to constrain our capacity to supply farmed fish with enough oxygen and to keep them safe from accumulation of wastes. Rob van de Ven explains, “Nowadays, with RAS, water availability hinders our capacity to keep the water free from less dangerous, but still aggravating agents. Nitrate, fine solids (which are mostly bacterial flocs) and sludge (which can lead to H₂S formation) are next on our laundry list of RAS problems to solve.”

“The cost, complexity and novelty of technologies to control nitrate, fine solids and microbes are often barriers to their commercial adoption”, Carlos Espinal adds. For instance, the use of ozonation is almost non-existent in Norway, but more prevalent in North America and Germany, where ozonation research has been historically undertaken.

The use of denitrification reactors is also rare in Norway as, historically, enough water has been available to control nitrate by dilution and water temperature control was not a requirement. However, denitrification technology is more prevalent in countries with water scarcity, stringent water discharge regulations or system heating needs. Israel, Germany, Denmark and the Netherlands are good examples.

To push Jevon's paradox away, at least for a while, Landing Aquaculture is developing some products which, hopefully, will increase the adoption fine solids filtration and denitrification technologies of in RAS.

Improved protein skimming

Protein skimmers are a common technique for treating fine solids in RAS. However, skimmer performance can vary wildly in each application. Salinity, gas



to liquid ratios, the presence (or absence) of oils, bubble size and the addition of ozone will affect efficiency.

Protein skimmer sizing and application are half science and half art, with no clear agreement among the experts on how much of the water of a RAS should be treated or what ozone doses are safe depending on the application. The use of protein skimmers in freshwater is limited and the fear of harmful ozonation residuals makes seawater RAS operators weary.

Landing Aquaculture is therefore developing a variant of the classic protein skimmer that they have named “DAFSkim”. Instead of a classic protein skimmer vessel, DAFSkim uses a specially designed dissolved air flotation chamber.

The chamber produces smaller bubbles and holds the process water for longer, resulting in an increased filtration efficiency. Instead of ozone, DAFSkim uses a peracetic acid and hydrogen peroxide mix which achieves a similar oxidation effect without the need for expensive ozonation equipment or the risks of using ozone gas.

The liquid compound is immiscible in water, requiring minimal mixing equipment and eliminating any needs for gas to liquid transfer devices. For RAS farms that already have ozonation equipment, DAFSkim can be operated with ozone, just like a



conventional skimmer.

DAFSkim comes from the development of Desline, a bloodwater treatment system developed by Landing Aquaculture in collaboration with Sandtorv Maskin (a Norwegian supplier of offshore and aquaculture solutions), Napier (a Norwegian shipping company), Innovation Norway and NOFIMA. The technology has proven to reduce color, oils and suspended solids in bloodwater. It also successfully inactivates bacteria such as *Aeromonas salmonicida*.

To bring DAFSkim to RAS, Landing Aquaculture is currently looking for academic and industry partners. With proper development and testing, the company expects to offer the market not only a more efficient, but also a more predictable way of controlling fine solids and microbes in both freshwater and seawater RAS.

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Simplified denitrification tech

Denitrification reactors can be highly efficient and compact. They can also be somewhat complicated, requiring monitoring and control systems. Denitrification reactors using fish sludge as a carbon source offer simplified operation and relatively lower costs – although they tend to be larger and less efficient. Their main difficulty: keeping the sludge inside the reactor vessel for the required time across a range of water flows.

Carlos Espinal explains the challenge, “We believe that cost and complexity are partly limiting the acceptance of denitrification systems in the market. To tackle this, Landing Aquaculture is developing a sludge reactor design which has no moving parts, no complex control systems and yet offers good performance”.

The reactor, coined DeSludge, is fitted with internal components that efficiently trap sludge and keep it under gentle mixing.

The sludge ferments under anaerobic conditions, providing denitrifying bacteria with the energy they need to convert nitrate to nitrogen gas. A RAS fitted with a Desludge unit is not only able to decrease its daily water requirement. But will also lower the cost of sludge transportation and disposal due to the thickening of the produced sludges.

Rob van de Ven closes, “We enjoy being creative as much as doing sound engineering work. We hope this leads us to technical solutions that the market can accept in the short term”

Landing Aquaculture is an engineering and consultancy company specialised in land-based intensive fish-farming and focused on creative, R&D-driven problem solving. Since 2014, Landing Aquaculture has completed more than 40 projects in 19 countries and continues to develop with a deeper focus in R&D and tailor-made solutions.

www.landingaquaculture.com



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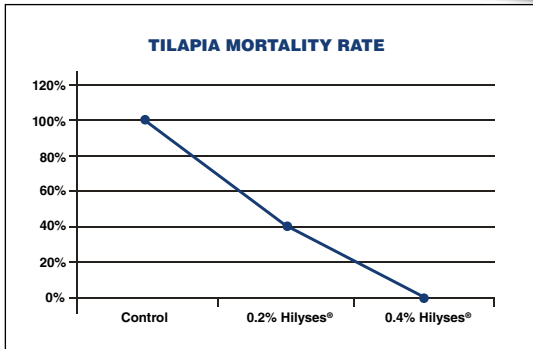
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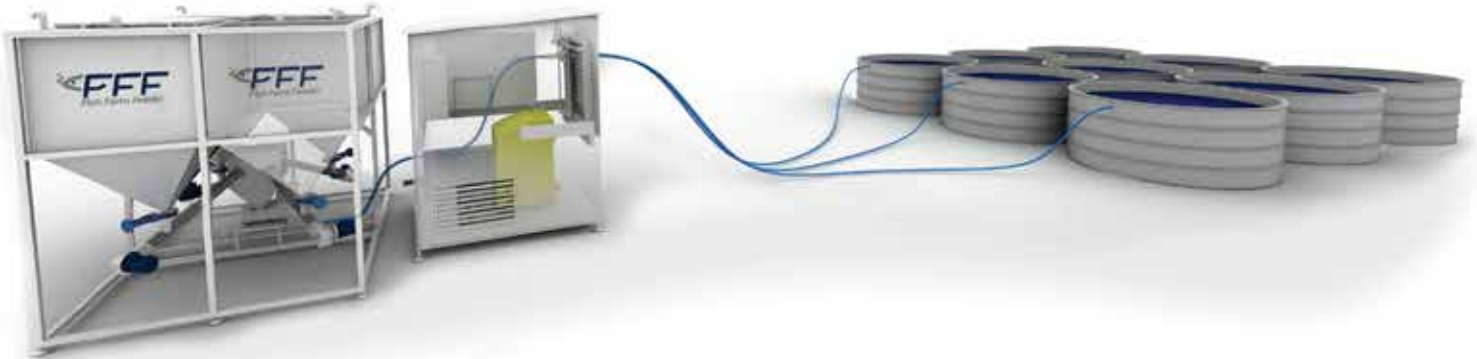
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* Fish Diseases and Management, Faculty of Veterinary Medicine, Cairo University, Egypt, 2017

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The Smart Aquaculture Photovoltaic Greenhouse (SAPG) project

by Dr Lu Jenn-Kan, National Taiwan Ocean University, Taiwan

In 2014, the world fish supply reached 16.2 million tonnes, which represent 20kg of fish per person. It reached a new record, mostly due to the tremendous growth of aquaculture, which provides now almost half of the fish stock (73.8 million tonnes in 2014), while capture production is saturating since 1990.

Experts all agree that aquaculture will contribute significantly in the future to food security and adequate nutrition for a global population expected to reach 9.7 billion by 2050.

Intensive and closed aquaculture systems

Recirculation aquaculture systems (RAS) represent a new and unique way to farm fish. Instead of the traditional method of growing fish outdoors in open ponds, this system rears fish at high densities, in indoor tanks with a “controlled” environment. Recirculating systems filter and clean the water for recycling back through fish culture tanks.

RAS offer fish producers a variety of important advantages over open pond culture. These include a method to maximise production on a limited supply of water and land, nearly complete environmental control to maximise fish growth year-round, the flexibility to locate production facilities near large markets, complete and convenient harvesting, and quick and effective disease control.

Alternative renewable energy for aquaculture

One of the fundamental issues facing all of us today is proper management of our energy resources. The current generation has a responsibility to ensure that energy is used efficiently and with minimum impact on the environment.

As considerations of fuel diversity, market uncertainties and environmental concerns are increasingly factored into electric utility resource planning, renewable energy technologies are beginning to find their place in the utility resource portfolio.

Most countries in Southeast Asia, they are experiencing strong economic and population growth. Its energy demand is currently increasing by ten percent each year and the competition for land use is growing as a result.

Some scholars have proposed to reduce fuel energy by apply renewable green energy sources such as solar and wind power. Fossil-based fuels are less cost-effective than renewable energies; energy is of little concern for the majority of the industry, and renewable energies are of potential use in recirculating aquaculture systems (RAS). In this project, we also want to demonstrate that dual land use for aquaculture and photovoltaics can solve these systemic problems.

The electricity charge accounts for about 20-40 percent of the total production cost of aquaculture, and the average monthly electricity consumption is more than 2,000 kilowatt hours.

In view of this, as well as the advent of the era of high energy prices and the trend of energy saving and carbon reduction, it is necessary to encourage farmers to use highly efficient electrical appliances, and encourage farmers, fish and livestock to make good use of solar energy, wind power and other self-generating ways to reduce CO₂ emissions.

The Aqua-PV greenhouse is 80L X 20W X 4.5H and the rooftop can install up to an incredible 720 solar panels; the generating power is about 407,808 kilowatts/year.

Smart Aqua-PV greenhouse system

Taiwan is located in the subtropical region, with long sunshine duration and small solar deflection angle. It is estimated that the average amount of sunshine per unit area is 129W/m², which is very suitable for the development of solar energy. Furthermore, the cost of solar power generation materials will decrease.

The design of Aqua-PV greenhouse systems includes a rooftop solar photovoltaic module, recirculating water system, water quality parameters monitoring system, double effect energy-saving aeration pump and LED lighting equipment.

The Aqua-PV greenhouse system (APVGS) integrates the solar-farm and fish-farm to reduce the extra energy input. According to initial analyses, the one-megawatt pilot plant in Taiwan should reduce CO₂ emissions by about 15,000 metric tonnes each year and cut water consumption by 75 percent compared to that of a conventional fish farm.

This aqua voltaic pilot plant is testing the technical and commercial feasibility of dual land use for solar power generation and commercial aquaculture purposes.

Smart recirculating raceway aquaculture system

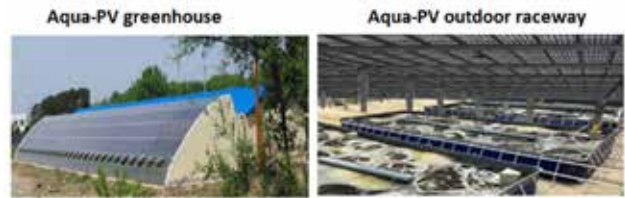
For reasons of hygiene, more and more aquaculture facilities in Taiwan and China are covered with closed greenhouses to prevent the introduction of diseases by birds or other aquatic animals. These canopies allow the integration of solar modules.

We consider on-land fish or shrimp farming in closed systems to be a promising approach to the careful use of land and water resources in the region. This more efficient use of land helps to preserve the remaining mangrove forests and significantly reduces water consumption.

In addition, the use of antibiotics is reduced to a minimum thanks to the sealed environment and the biofloc system, where the aquatic animals are fed on micro-organisms in a closed loop. By providing shade, the solar modules integrated into the housing improve working conditions for the employees at the facility. They also offer protection from predators and maintain an optimal water temperature enhancing fish and shrimp growth.

ICT and AIOT technology for precise aquaculture

To enhance and improve aquaculture production by IOT technologies that pulls data from various sensors and satellites,



the massive data recovered from such sensors is put to use to make aquaculture operations more efficient and eco-friendlier using cloud-based analytic software tools.

In this smart Aqua-PV project, we employ AIOT technology and biotechnology strategies to revolutionise aquaculture.

• **Advanced monitoring of environmental water quality by AIOT technology:**

Using ICT and AIOT technology the operator has a full overview of water quality parameters such as dissolved oxygen, temperature, pH, salinity, NH₃ etc. which can be constantly monitored. Early warning systems and water quality conditioning equipment adjusters are included Automatic species recognition, weight determination and precise feeding systems: We demonstrated that using a vision-based biometric system can automatically recognise fish species and measure the body length to then convert to body weight. The concept of precision feeding systems is using highly digestible feed sources in a controlled feeding environment with an emphasis on feed efficiency, reducing daily ration costs, and minimising faeces output

• **On-line diagnosis systems for fish diseases:**

Rapid and accurate diagnosis is required to control such

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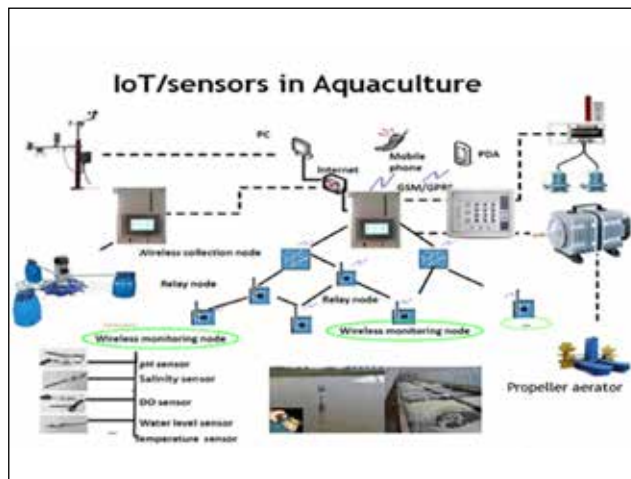
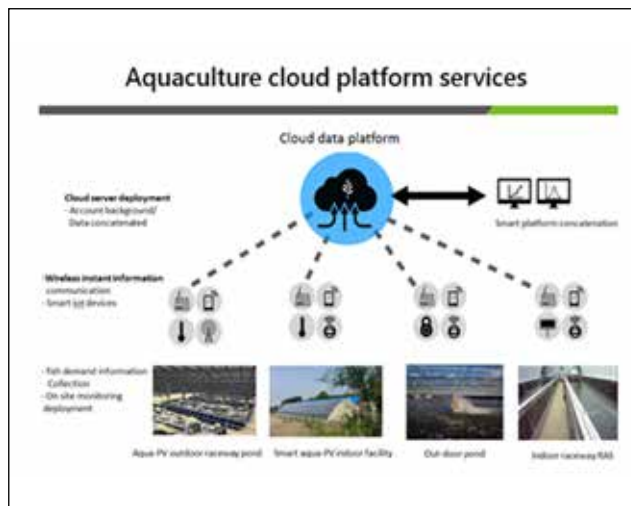
diseases, prevent their spread and limit excessive use of antibiotics. IoT technology and a clinical sign-based diagnosis aid system is applied by sending infected animals' images, text description through a mobile phone to the diagnosis centre. To implement the designed diagnosis process, fish disease databases and disease cause/prevention/treatment databases were established. Information such as cause of disease, diagnosis, treatment and prevention method of candidate disease are provided as a medical advice through internet to user PC or mobile devices. This system will support fish farmers and veterinarians by providing easy and rapid diagnosis of fish diseases.

This project demonstrates the added value that can be generated by integrating photovoltaics into different areas of life. This is particularly true for aquaculture, for this Aqua-PV system, we estimate that the land use rate can be almost doubled compared with a ground-mounted PV system alone in other places within the southern part of Taiwan.

This project aims to develop a solution not only for big plants but also for small and medium-sized aquaculture businesses. This will make the approach accessible for the average rural inhabitant in terms of the technology and investment needed.

The market launch of the Aqua-PV technology combined with the efforts of local partners should help drive improvements to energy security in the region as well as boosting its economy. With aquaculture and photovoltaics experiencing rapid growth worldwide, the project team believes that their approach has a lot to offer for many other developing and industrialising nations.

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Top technology at Aquaculture Europe

December 2019

This December, International Aquafeed take a look at the latest innovations for fish farming that make your work quick, easy and reliable.

This month we take a look at a variety of innovations, including underwater cameras, cleaners, feed spreaders and lice skirts.

Guardian Wireless Monitoring System

Guardian is a wireless system for monitoring and logging of environmental data in fish farming: Oxygen, temperature, salinity, turbidity and water currents. The Guardian can be configured with up to three different or identical probes, wholly optional according to what one wants to measure, and at which depths. Guardian consists of measuring buoys and charging stations and comes with a finished website where you log in to view the measurements, no installation is required. The Guardian buoys can also be reprogrammed with SMS while in function. Guardian makes it easy to achieve updated information about the environment in the cages. Measurements are sent with GSM to database in the cloud. The program arranges data in different ways and stores statistical information that can be presented by day, week, month, half year or year. The sensors need no calibration or service. The Guardian is equipped with the best in advanced measurement technology, wireless communication and battery technology.

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Fuglesang's Ansmag KM

Simple by design, this process pump delivers world class performance in a remarkably compact footprint. With no seals or mechanical couplings to leak or fail, this pump for chemical applications is the safest choice for those looking to protect personnel and the environment. Additionally, the process pumps from the KM series feature fewer wetted parts than competitive products and a powder coat finish to prevent corrosion, delivering enhanced durability, optimal reliability and lower through-life costs over traditional sealed pumps. Built to meet exacting ASME / ANSI B73.3 process pump standards, these pumps are dimensionally interchangeable and represent the easy upgrade option from standard mechanically sealed pumps.

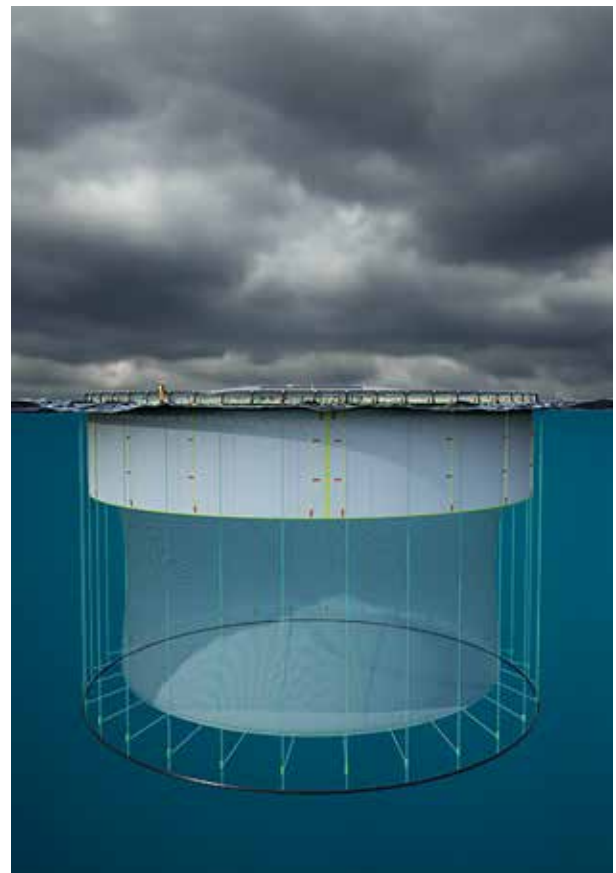
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Botngaard's Perma Skirt

With the Perma Skirt, Botngaard have revolutionised the way lice skirts are made. Three and a half years of product development have resulted in a skirt that gives extreme value for money. Sea lice are, along with escapes, considered the biggest challenge for the aquaculture industry today. We are seeing major sea lice infestation on fish residing in the upper water layers. Shielding of the upper portion of a cage may therefore reduce sea lice infestation significantly. Lice Skirt V-2018 has been tested and tried in tough conditions, is superior against abrasion, floats better at sea with a slimmer design and maximal UV-protection. The Perma Skirt leads to 50-80 percent less sea lice infestation, fewer delousings, less use of chemicals and less handling of fish.

www.botngaard.no



JT Electric's Ocean Camera

The Ocean Camera is a very compact and light-sensitive underwater television camera specially developed for monitoring fish feeding in the aquaculture industry. The camera view is automatically directed vertically towards the surface by a float jacket when the camera cable is tethered to the net base. Feed pellets not eaten by the fish are clearly visible as they descend, and the special camera lens design prevents any feed and debris accumulation causing obscured vision. Ocean Camera is versatile, robust & cost effective for monitoring.

<http://jt.fo>



LOWCASE

Imenco's OE15-100d/101d Camera

The OE15-100D/101D is a high-resolution monochrome camera available in both CCIR (PAL) and EIA RS 170A (NTSC) video output formats. The camera offers exceptional low light sensitivity for applications with poor scene illumination, yet effectively replicating well illuminated scenes in high fidelity.

The wide AOV (102°) benefits the operator with excellent situational awareness for navigation and general viewing applications. Whilst the water corrected optical arrangement minimises distortion and aberrations.

The highly advanced internal electronic assembly is protected from harsh environments by a titanium alloy housing, depth rated to 4,500 msw. The camera is supplied with an IR remote, allowing the user refined control of long line drive.

<https://imenco.no>



KSK Aqua's Saddle Chips

Saddle Chips are designed as an open element for easy cleaning and maintenance. In addition, the saddle shape of the element contributes to good hydraulic properties that, among other things, result in exceptional distribution of the water and low pressure drop in fixed bed filters. Furthermore, Saddle Chips have a unique design that provides optimal hydraulics around the elements so that the entire surface gets fresh water, resulting in high performance of filters.

This solution has also been designed in such a way so that Saddle Chips will not tangle, but instead will float freely in the water.

www.ksk-aqua.dk



NorseAqua's Loke Cone Feed Spreader

The Loke Cone Feeder improves distribution of feed in salmon pens. The spreader gives users a larger and more evenly spread of feed. Developed together with Salmar, the patented spreader lets users get started earlier with feeding and improve control.

Users can control the spread from their control room and with no moveable parts, they no longer need to worry about unreliable bearings of traditional feed spreaders.

There are numerous benefits to this device, including it being proven to cause a more efficient start feeding of smolt, better survival of the smolt, less waste of feed and less variation in the size of the fish.

<https://norseaqua.com>



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The ECA Hytec H800 boasts portability at only 11kg, whilst also being extremely powerful. There is easy access for any maintenance check-ups and a high performance viewing system.

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EXPERT TOPIC

Wreckfish

Exploring the biological and socio-economic potential of new-emerging candidate fish species for the expansion of the European aquaculture industry – the DIVERSIFY project (EU FP7-GA603121)



by Álvarez-Blázquez¹, B.,
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⁴CTAQUA, Cadiz, Spain; actual affiliation TESTING BLUE S.L., Cádiz, Spain.

⁵Xunta de Galicia, Centro de Investigaciones Mariñas, Vilanova de Arousa, Spain.

Following the series of articles published on the fish species included in the EU-funded DIVERSIFY project (see April, May, June, July and October issues of *International Aquafeed*), which ran between 2013 and 2018, we present here the wreckfish (*Polyprion americanus*), which was the most challenging species in the project.

The wreckfish is one of the largest Polyprionidae species, reaching a size of 100 kg. It is a deep-water fish (100 to 1000 m) found almost throughout the world and is characterised by an extended pelagic juvenile phase (Ball et al., 2000; Sedberry et al., 1999). It is one of the most interesting new species for aquaculture, due to its fast growth (Suquet & La Pomélie, 2002; Rodríguez-Villanueva et al., 2011), late reproductive maturation, high market price and limited fisheries landings (See Figure 1) and easy handling in captivity with no mortality recorded during the DIVERSIFY trials (Papandroulakis et al., 2008). Its large size makes it appropriate for processing and development of value-added products, which could be of interest for the EU market.

Wreckfish accepts inert food easily, being a very voracious carnivore. Wild-caught individuals kept in captivity grew from one-to-five kilogrammes in a period of 10 months (Rodríguez-Villanueva et al., 2011). The slow reproductive maturation of wreckfish, which occurs at an age of 5-10 years in captivity, may be a problem for broodstock development and management. On the other hand, its long juvenile stage is a great advantage from the aquaculture viewpoint, allowing for commercialisation before sexual maturity, and thus avoiding problems linked to maturation, such as reduction in growth. It has been demonstrated that growth is strongly influenced by sex and that female wreckfish are significantly heavier than males, as observed in many other marine fish species (Rodríguez, 2017).

The world wreckfish population is composed of three genetically distinct stocks: 1) the North Atlantic and the Mediterranean Sea, 2) Brazil and 3) the South Pacific (Ball et al., 2000). Wreckfish is a gonochoristic species with no sexual dimorphism and spawning occurs at the continental slope at depths of 300-500 m, with the formation of spawning aggregations (Peres and Klippel, 2003). Demersal wreckfish individuals inhabit rocky and muddy bottoms, at depths of 40-200 m; however, individuals are frequently found in waters deeper than 300 m, with a maximum recorded depth of 1000 m (Fischer et al., 1987). For the first part of its life (from hatching to a body length about 60 cm) wreckfish is pelagic and lives in association with floating debris.

The work of DIVERSIFY for this species has focused in the areas of reproduction and genetics, larviculture and nutrition, which have been the major bottlenecks preventing wreckfish aquaculture so far.

Reproduction and genetics

Three stocks (See Figure 2) have been maintained at the facilities of three Galician institutions (Spain): Institute of Oceanography (IEO), Ayuntamiento de A Coruña, (MC2) and Conselleria do Mar from the Xunta de Galicia (CMRM). In addition, one stock was maintained at the Hellenic Centre for Marine Research (HCMR) in Crete, Greece. The reproductive development of these stocks was followed for two years. The reproductive period (oogenesis, maturation and spawning) was rather long in wreckfish, beginning in October and lasting all the way to July, especially in the

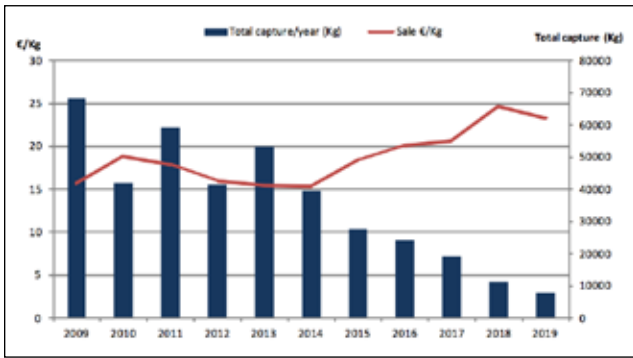


Figure 1: Evolution of wreckfish captures and sales in the last 10 years in the Galician markets (Pescadegalicia.gal.XuntadeGalicia)



Figure 2: Wreckfish broodstock at the MC2 facilities (picture by Antonio Vilar)

Spanish broodstocks that were exposed to lower temperatures during the year. The highest oocyte diameter of wreckfish was found between March and July, suggesting that this is the expected spawning period. The egg size of wreckfish (~2mm in diameter) is markedly larger than any other marine fish cultured in the temperate waters of the Atlantic coast of Europe and the Mediterranean Sea (Papadaki et al., 2018). A large egg size and lower fecundity is considered essential for demersal fishes, as it is related to higher individual survival in a relatively constant environment, in contrast to pelagic small eggs that have to face a changing environment, where survival is more difficult and thus high fecundity is more advantageous. Embryonic development and early life stages have been described (Papandroulakis et al., 2008; Peleteiro et al., 2011), indicating that the large egg size of this species may offer significant advantages for its larval rearing.

Constant temperature of 16°C throughout the year (HCMR, Greece), although probably more representative of the environment to which wreckfish breeders are exposed to in

the deep waters that they inhabit in the wild, did not seem to have any beneficial effects on the reproductive development of captive female wreckfish. Fish held under naturally fluctuating temperatures in the Spain stocks exhibited the same or better reproductive performance than fish under constant temperatures in Greece, i.e. they matured and spawned spontaneously. On the other hand, males, maintained under constant temperature in the HCMR stock, remained in full spermiation for almost the whole monitoring period compared to males exposed to annual cycling temperatures in Spain, suggesting that perhaps males responded differently than females to the two different temperature regimes of the study.

Spontaneous spawns have been obtained from the three Galician stocks, with increasing regularity of spawns and fertilisation rates as the project progressed and more experience was acquired (See Figure 3). Relative batch fecundity was also variable among the four wreckfish broodstocks in the present study, varying between 2,000 and 30,000 eggs spawn⁻¹ kg⁻¹



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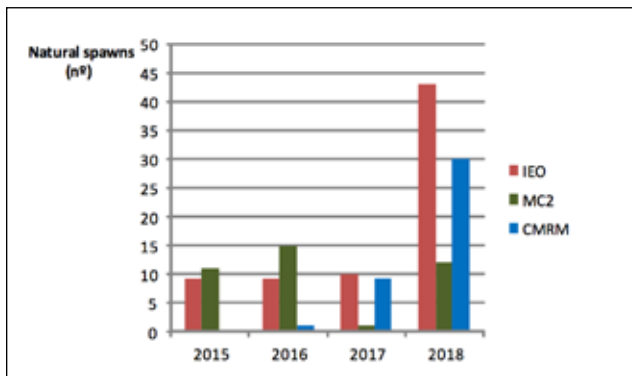


Figure 3: Total number of natural spawns of the three Galician broodstocks (IEO, MC2 and CMRM) during 2015-2018



Figures 4a and 4b: Procedures to obtain wreckfish spawns in captivity

body weight. Limited egg collection has been also achieved from captive spawners after hormonal induction and tank spawning or manual stripping of maturing individuals. During the last year of DIVERSIFY in 2018, spawning became more consistent with better fecundity and fertilization in the Spanish broodstocks. Based on the obtained results, we expect that full acclimatisation of the species to captivity can result in consistent natural spawning and production of good quality eggs.

Spawning takes place during the night or very early in the morning (between 05:00 and 08:00h, with some exceptions at noon). In 2017 and 2018, spontaneous spawning at the IEO, MC2 and CMRM stocks produced a large number of fertilised eggs. Spawning periodicity was 3-5 days in all stocks and fertilisation success ranged between 50 and 100 percent with improved egg quality towards the second half of the spawning season for each female. It has been found that a female is able to spawn up to ten times per breeding season, while the same male has fertilised at least 30 spawns in a total period of 150 days.

The response of the females to treatment with gonadotropin releasing hormone agonists (GnRH_a) implants in order to induce spawning has been variable, with irregular results in terms of fecundity and egg quality. In some occasions tank spawns or stripped spawns yielded non-viable eggs, and in other occasions even though the fertilisation was a success, hatching was zero. Artificial spawning by stripping could be the method of choice with mature females that exhibit problems to spawn spontaneously after GnRH_a induction (See Figure 4). In the case of females that naturally undergo oocyte maturation (without exogenous hormones) it is not advisable to use stripping, since the stress caused by the manipulations could result in poor egg quality and lack of fertilisation success.

With respect to the male characteristics, sexual maturation takes place from March to July as in the case of females, reaching its peak during April and June. All studied sperm quality parameters varied significantly during the two years of the study, but without any clear correlation with the female breeding season (March-June). Overall, sperm quality was considered high throughout the year. Mean sperm density ranged between 4.5-11.5 x 10⁹ spermatozoa ml⁻¹, sperm motility was always higher than 60 percent, motility duration ranged between 1.5 and 6 min and survival of sperm at 4°C ranged between 3 and 10 days, although in some cases a survival of 18 days was achieved (Pérez Rial, 2019). Sperm density was very similar to other pelagic species, such as European sea bass (*Dicentrarchus labrax*), gilthead sea bream (*Sparus aurata*) or meagre (*Argyrosomus regius*). However, wreckfish sperm concentration is higher than the one found in sole (*Solea solea*) and turbot (*Scophthalmus maximus*).

There are three possible procedures to obtain wreckfish spawns in captivity (See Figure 5):

- Expose breeders to natural photothermal conditions in large tanks (>40 m³) and obtain spontaneous spawns
- Induce spawning with hormonal implants loaded with GnRH_a, if fish do not undergo maturation and spawning spontaneously, and allow the fish to spawn in the tanks
- Induce maturation and ovulation by hormonal treatment, and strip-spawn the eggs followed by *in vitro* fertilisation.

Despite the easy handling of this species in captivity, its large size requires large tanks to guarantee its well-being and avoid stress-induced reproductive dysfunctions, that would affect gametogenesis and maturation. Although it is possible to strip-spawn wreckfish and fertilise the eggs *in vitro* after hormonal induction of ovulation the frequent handling of the females is problematic when dealing with such large fish. During the project, it has been shown that wreckfish are able to reproduce spontaneously with very good results in egg fecundity and fertilisation, and this is the recommended method of reproduction with a view to the industrial aquaculture production of this species.

Reproduction and larval rearing of a very close species, the hapuku (*Polyprion oxygeneios*) has been achieved only recently in New Zealand (Anderson et al., 2012; Symonds et al., 2014; Wylie et al., 2018). The scarcity of broodstock is a disadvantage for the culture of wreckfish, but the clear biological and economical potential of this species justified allocation of part of the effort of DIVERSIFY in bringing together almost all European partners involved so far in wreckfish domestication, to overcome its documented bottlenecks --i.e., reproduction and larval rearing-- in order to produce appropriate numbers of juveniles to launch commercial production.

Larviculture

During the first stages of egg development, vulnerability to external conditions is the highest. Optimal incubation temperature and larval culture conditions have been adjusted in the facilities of the IEO in order to have a correct embryonic development (Álvarez-Blázquez et al., 2016). Zootechnical aspects such as aeration, tank hydrodynamics and water flow have been optimised. These are essential parameters to diminish larval malformation, which is an issue that would need further investigation. During wreckfish larviculture trials in DIVERSIFY (See Figure 6), malformations were found that may be similar to a syndrome that is related to the consumption of the yolk sac (SYSS) described by Gunakesera et al (1998) or also to the 'blue sac disease' (BSD) described for common trout. Further studies will be necessary to identify this problem.

In wreckfish, the ontogenesis of the digestive system is considered a slow procedure compared to other species. The

development of the digestive system is controlled by endogenous factors and is generally genetically programmed, but the time of appearance of the structures of the digestive system may be influenced by a series of exogenous factors, with temperature being one of the most important (Kamler, 2002). In addition, it was found that the ontogeny of the retina is similar to the general pattern of most fish species. In hatching, the retina is an undifferentiated and non-functional tissue, as occurs in most marine fish with pelagic stages of early life (Pankhurst and Eagar, 1996; Pankhurst and Hilder, 1998; Pankhurst et al., 2002; Roo et al., 1999; Shand et al., 1999). Cone cells were the first photoreceptors to appear (6 dph). This fact indicates that after 5 dph fish can identify food such as rotifers and *Artemia nauplii*.

Within the DIVERSIFY trials, larval hatching ranged between 42 and 82 percent, which can be considered very acceptable. However, larval survival has been rather limited. Only during the last year of the project, it has been possible to obtain some larvae that have been successfully weaned and juveniles have been obtained and cultured at the facilities of the IGAFa (Galician Institute of Aquaculture, Spain), which is an CMRM collaborating organisation. This was the first time in the project that we succeeded in producing juveniles weaned to inert food (See Figure 7), and it is a milestone in the efforts to produce wreckfish under aquaculture conditions. This trial has provided important data on wreckfish growth and has increased our knowledge about the feeding protocol and the specific behavior and metamorphosis of wreckfish larvae (Rodríguez et al, 2019).

During the last year of the project, a large number of experimental trials were carried out in larval culture, focusing on adjusting different culture systems (flow through, mesocosm and recirculating aquaculture systems, RAS) and environmental parameters such as water temperature, culture volume, larval density, food sequence, air, light, shape and color of the tanks.

The best results were achieved with RAS at the IGAFa facilities with two batches of larvae from IEO and MC2 spawnings. The food was based on rotifers, *Artemia nauplii* and enriched *metanauplii*. Both batches of larvae reached the weaning period and are currently in the juvenile phase (See Figure 8). This is the first time that a batch of wreckfish juveniles was produced under cultivation conditions and represents a milestone in our efforts to make this species a firm candidate for exploitation on

an industrial scale.

The main results from the wreckfish larviculture experimental work in the DIVERSIFY project have been published (Pérez Rial et al., 2019) and can be summarised as follows:

- The ontogenesis of the organs related to the digestive system and vision system was not completed until day 23 post-hatching. Most of the organs (except the maxillary teeth in the upper jaw that became visible at 19 dph), appeared by 8 dph.
- The optimal temperature for egg incubation is in the range of 16.5-19.5°C. Lower temperatures (14±0.5°C) promote higher larval deformities and low hatching rates, with higher mortalities during the first three days of incubation. Larval culture temperature between 16-18°C is adequate for greater survival and growth.
- The newly hatched larvae are characterised by their large yolk sac, storing endogenous reserves until day 20 dph at 17±0.5°C. The large yolk sac and the slow absorption of the lipid droplet indicate a long period of autotrophic nutrition.
- A larval feeding sequence was defined in the recirculation system that gave good results at a temperature of 17.5-18°C, with a natural photoperiod from 7-9 dph. Feeding live food protocol: rotifer enriched with an arachidonic acid (ARA) supplement from 8-19 dph, *Artemia nauplii* from 15 to 23 dph and *Artemia metanauplii* from 18 to 48 dph. Inert food was administered from 40 dph onwards.
- The incubation and larval culture technologies were adjusted to the requirements of this species and important results were achieved with the larval culture in RAS (Rodríguez et al., 2019).

Nutrition

Nutritional requirements of wreckfish were unknown so far and there were only a few references related to feeding habitats from commercial captures (Brick Peres & Haimovi, 2003) and feeding rates in captivity (Papandroulakis et al., 2004). Recently some studies were done on the composition of wild wreckfish (Roncarati et al., 2014; Linares et al., 2015) and their morphometric characteristics (Álvarez-Blázquez et al., 2015). The optimum development of broodstock diets for wreckfish is essential for the future of its aquaculture. Dietary lipids and especially fatty acids play a critical role in the successful production of high-quality

gametes and eggs of marine fish (Izquierdo et al., 2001; Sargent et al., 2002). Also, the development of enrichment products of live prey is very important for the success in the larval culture. The understanding of the polyunsaturated fatty acid (PUFA) requirements of marine fish larvae requires the definition of optimal dietary ratio of DHA, EPA and ARA.

Based on data of biochemical analyses of gonads from wild wreckfish females, eggs and larvae obtained from reared fish, some live feed enrichment products were developed for larval wreckfish. Some nutritional experiments with wreckfish larvae were performed in DIVERSIFY showing that larvae exhibit, in general, a good acceptance of the enriched live prey tested and no differences in fatty acid composition of wreckfish larvae fed with the prey enriched with the enrichment products tested were found at different days of live. The fatty acid profile of wreckfish larvae along the larval

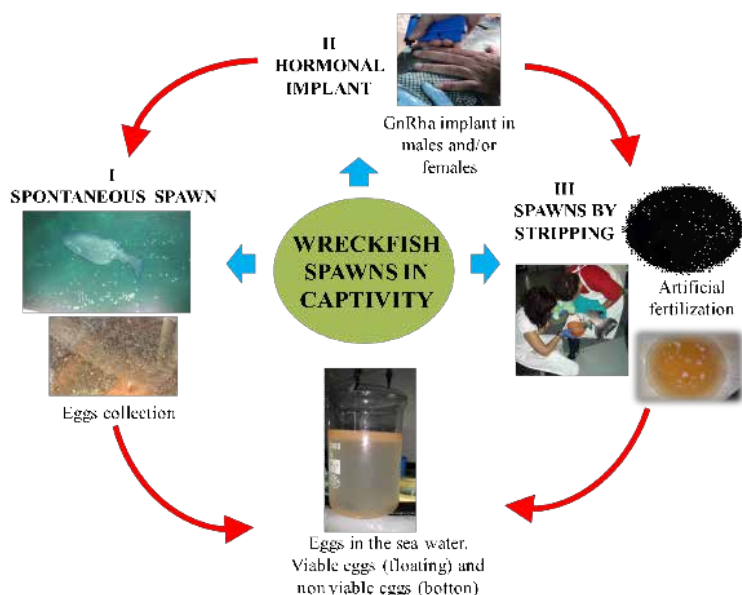


Figure 5: Overview of the different procedures for spawning of wreckfish

development shows big amounts of PUFA specially DHA, EPA and ARA. Furthermore, there is a clear relationship between fatty acid profile of broodstock feed supplied and fatty acid profile of oocytes and eggs (Linares et al., 2016, 2018)

The results obtained regarding the composition of tissues of wild specimens were very useful to advance in the knowledge of the nutritional requirements of this species, which shows a large amount of proteins and a low level of lipids in the muscle. In addition, the results suggest that the enriched live prey used as food for the larvae is well digested. Although so far, the larvae have a very low survival rate, the results in 2018, with the obtaining of the first juveniles, are very promising.

It is quite apparent that this species exhibits a fast growth rate and an easy adaptation to the captive environment and handling procedures. Low feeding rates were recorded during the spawning season (from March to July) and high feeding rates occurred during autumn. Ingestion rate varied between 0.2 and 0.5 percent for fish fed with semi-moist diet, and between 1 and 1.8 percent for those fed dry pellets (Pérez Rial, 2019). The results obtained during the DIVERSIFY project in terms of nutrition can be summarised in the following points:

Wreckfish have a big amount of proteins in their muscle (84% in wild fish and 78% in reared fish) and the level of lipids is lower in the muscle from wild fish (7% DW) than in reared fish (25%). Concerning fatty acid composition in muscle, values of PUFA and $\Sigma n-3$ are higher in wild wreckfish (39 and 34% of total fatty acids respectively) than in reared fish (30 and 24%). DHA values represent 12 percent in cultured fish and 26 percent in wild fish. EPA content represents seven percent in reared fish and four percent in wild fish and ARA 1.6 percent and 3.1 percent in reared and wild fish respectively. The EPA/ARA ratio has values of 4.6 in reared fish and 1.5 in wild fish (Linares et al, 2015).

Significant advances were made in the knowledge of this species in terms of its biology, nutrition, reproduction and physiology, as well as its adaptation to captivity, reproduction technology and larval culture and the first knowledge of its larval ontogeny was provided. The results obtained, as well as the shortage of specimens in the natural environment, are two aspects of great importance to continue dedicating research efforts on the development of aquaculture for this species. It is considered a high potential species with a view to the diversification of industrial aquaculture. Having managed to obtain juveniles in captivity has generated a great impact in the aquaculture sector, interested in diversifying and innovating. The general interest in scientific advances in cultivation is high, and in particular of the companies that currently hold stocks of mature specimens of this species (mainly in Spain).

A Technical Manual on the wreckfish culture can be downloaded at the project website: <https://www.diversifyfish.eu/wreckfish-workshop.html> where a video on a standardised method on sperm analyses applied to wreckfish is included (done by Dr Christian Fauvel of IFREMER, France).

Want to know more? Please visit www.diversifyfish.eu.



This 5-year-long project (2013-2018) has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration (KBBE-2013-07 single stage, GA 603121, DIVERSIFY). The consortium includes 38 partners from 12 European countries –including 9 SMEs, 2 Large Enterprises, 5 professional associations and 1 Consumer NGO– and is coordinated by the Hellenic Center for Marine Research, Greece. Further information may be obtained from the project site at “www.diversifyfish.eu”.



Figure 6: Image of a 15 dph wreckfish larvae



Figure 7: Image of a 97 dph wreckfish fingerling



Figure 8: Wreckfish juveniles at the IGAF facilities (picture by Sonia Díaz Carballal)

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<http://bit.ly/aqex20bangkok>

23
Aquatic Health and Nutrition Asia Conference @ VICTAM and Animal Health and Nutrition Asia
 Bangkok, Thailand
bit.ly/aquatic20

24-26
VICTAM and Animal Health and Nutrition Asia
 Bangkok, Thailand
www.victam.com
www.viv.net

25
Build My Feedmill Conference
 Bangkok, Thailand
bit.ly/bmfmbangkok20

The Build My Feed Mill Seminar will once again take place during VICTAM Asia and Animal Health and Nutrition Asia on March 25th 2020, 13:30-15:30.

During the Build my Feed Mill Conference, 10-12 companies are given the chance to present 10-minute presentations about how their solutions assist feed millers in their everyday processes and practices.

Currently confirmed speakers at the event include FrigorTec GmbH, Amandus Kahl and SCE Silo Construction and Engineering. Speaking slots are still available for a short period of time: contact Rebecca Sherratt at rebeccas@perendale.co.uk for more information.

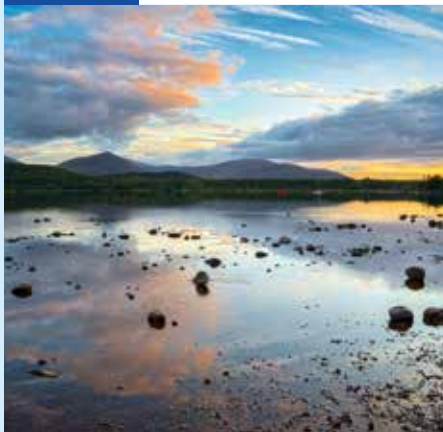
2020 April

7-9
Livestock Malaysia 2020
 Malacca, Malaysia
www.livestockmalaysia.com

2020 May

7-13
Interpack 2020
 Düsseldorf, Germany
www.interpack.com

19-21
Aquaculture UK
 Aviemore, Scotland, UK
www.aquacultureuk.com



28-30
Livestock Philippines 2020
 Manila, Philippines
www.livestockphilippines.com

2020 June

8-12
World Aquaculture 2020
 Singapore
www.was.org



23-26
FOOMA Japan 2020
 Osaka, Japan
www.foomajapan.jp

2020 July

8-10
Indo Livestock 2020
 Jakarta, Indonesia
www.indolivestock.com

2020 August

18-21
Nor-Fishing 2020
 Trondheim, Norway
www.nor-fishing.no



2020 September

15-18
SPACE 2020
 France
<http://uk.space.fr>

7-10
LACQUA 2020
 Guayaquil, Ecuador

24-26
Taiwan International Fisheries and Seafood Show 2020
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Dr Eckel celebrates 25th anniversary with customers and partners

On the occasion of its 25th anniversary, Dr Eckel Animal Nutrition, industry pioneer and expert in innovative feed additives, hosted customers, partners, specialists, experts and scientists at this year's International Eckknowlogy® Conference from 4-5th November.

More than 70 international participants from the science, agriculture, feed and food production sectors attended the 'Your future with Dr Eckel: Profitable, sustainable, animal welfare' trade conference at the Dorint Parkhotel Bad Neuenahr.

They concluded that modern animal nutrition must find a balance between animal welfare and profitability in order to be applicable to the future. The significance of the occasion did not take second place to the technical lectures, discussions and networking: a convivial dinner was followed by a tantalising evening programme.

"It was a great mix of high-calibre expert talks, inspiring debates and plenty of opportunity for discussions with international industry peers," said Bernhard große Austing from Austing Mischfutterwerk GmbH & Co KG, adding, "Animal welfare is no trivial matter. Rather, as amply demonstrated at this conference, it is a necessity. Only healthy animals can provide healthy food. Because ultimately, this is what the consumer wants and what our world needs in order to ensure sufficient food supplies in the future."



Founder and CEO Dr Antje Eckel has expressed her gratitude for all that has been achieved and promised many more innovations, "Twenty-five years of Dr Eckel that's 25 years of innovation, growth and success for and with our customers. We are proud to be able to celebrate this today, a privilege for which we are very grateful.

"The world has changed fundamentally in recent years. The momentum of the climate debate, the debate on the production of animal protein and the matter of animal welfare have transformed the issue of animal nutrition into an economic and political hot potato. Our vision is to integrate animal welfare, economic viability and food quality in a novel manner. We subscribe to a holistic approach that goes way beyond today, for the sake of our future."

Fish International: Packaging and animal welfare

New products, the Packaging Directive, sustainability and animal welfare in aquaculture are just some of the topics at the heart of the fish international from February 9-11th, 2020 at Messe Bremen. Once again, the organisers of Germany's only fish trade fair will give visitors from the industry, retailing and horeca a forum for swapping and discussing new ideas.

As a showcase for new products, the fish international 2020 has a lot to offer, especially as many exhibitors are coming for the first time. For example, Turkey's largest fish farming company will be presenting its Olive Flounder (*Paralichthys olivaceus*) in Bremen. Cooks in Asia value this meaty fish for sushi and sashimi, but it is largely unknown in many places worldwide.

A company from Java is keen to tap into the German market with its sustainably farmed tilapia and products such as fillet of tilapia in Parmesan crust.

"We've identified a trend towards more frozen and convenience products", says Sabine Wedell, Project Manager of the trade show. One more example of this is an Irish company presenting new spice mixes and toppings for salmon, cod, hake and other fish.

One of today's major concerns is protection of the environment. This has led to new regulations such as a directive that demands packaging must be "especially recyclable". The engineer Till Isensee will give a presentation that illustrates the confusion caused by this vague description.

For almost ten years, fish international has been continually extending the exhibition's focus on aquaculture. This time, vendors can also use the SCOPE Lounge for talks with their customers.

One organisation taking advantage of this offer is the Initiativkreis Tierschutzstandards Aquakultur (Initiative for Animal Welfare Standards in Aquaculture), which unites scientists, associations and major retail chains.

"It looks for example at options for stunning fish before slaughter. In most countries, stunning is neither required by law nor practiced," says Sabine Wedell. She is confident the initiative's ideas will have an impact. "Because of the market power of the retailers, they have a far-reaching influence. Especially as they buy not only in Germany."

The trade fair programme also includes tastings in the "Räucherbox" smoke house, a special counter show, the award of the Seafood Star for good concepts for instance in fish retailing and the presentation of their certificates to newly qualified fish sommeliers.





TAIWAN INTERNATIONAL FISHERIES & SEAFOOD SHOW

Taiwan's largest fishery trade event connecting industry professionals took place on September 26-28th, 2019 at the Kaohsiung Exhibition Centre in Kaohsiung, Taiwan, an event which International Aquafeed magazine were very happy to attend.

This year's exposition is the fifth rendition of the popular Taiwan International Fisheries and Seafood show (TIFSS). As one of Taiwan's most important fishery and seafood trade events, the show was a huge success and attracted over 170 exhibitors and 340 booths. Over 10,000 foreign and domestic professional buyers also attended the event, a record-breaking number which demonstrates how much the event is continuing to grow.

It is very clear that the event is continuing to expand, as the variety of topics concerning marine life that were covered at the event have expanded significantly, compared to previous renditions of the event. Aquaculture, marine biotechnology, fishing tackles, seafood, seafood processing and fishing equipment were all key sectors that the event catered to, giving attendees a much wider scope of topics to explore as they browsed the stands.

The event was opened up by Director Donald Lu from the Taiwan External Development Council, who gave welcome remarks, followed by Peter D M Chiang, Founder of Hanaqua Tech Inc, who discussed the aquaculture industry on a global scale, as well as international certification. Other expert speakers included Chao-nan Chen, Director of the Kaohsiung Industry Development Association and professor Masuma of Kindai University.

Improving year on year

There were several areas of the exhibition which also reflected the large area of growth within the aquaculture sector in Taiwan. One new feature was the 'Fishing Tackle Exhibition Area', which brought 16 exhibitors from all over the world to attend, including Abu Garcia from the US, Daiwa from Japan, Okuma, Etnoh, Anten and more from Taiwan. As a result of this new update, any fishermen also attended the event and brought new experience and interests to the aquaculture event.

The event was also broadcast online live by several prominent members of the fishing industry. An exclusive indoor 'Shrimp Fishing Experience' was also held, which allowed fishermen to experience indoor fish shrimping and the queues to join this fun event proved its popularity.

Along with this update, a variety of other specialised sections in the event included the Fishing Equipment and Technology Area, Seafood Process Area, Marine Biotechnology Area and Aquaculture Area. The International Aquafeed team were indeed very impressed to see a renewed focus on fish farming and aquatic technologies at the fifth rendition of the Taiwan International Fisheries and Seafood Show, which really reflects that the event is keeping updated on all the latest innovations in the sector.

The event also boasted a great scope of international companies, speakers and attendees. In particular, Taiwan's top product importers for fishery products are China, Norway, Japan, Vietnam and Indonesia, and companies from these countries flocked en masse to attend the event, as well as members from countries all over the globe.

Seminars were also regularly held throughout the three-day event, the most prominent being the 'World Aquaculture Techniques and Marketing Outlook 2019' seminar, which featured discussions concerning the history of fishing and the current conditions of bluefin tuna, popular in Japan, by the Director of the Fisheries Research Institute of Kindai University. Professor Sheenan Harpaz of the Agricultural Research Organisation (ARO), Israel, also discussed innovation and research in Israel, particularly the concept of smart aquaculture development. Me Cesar Aurelio Morales Perez, the Regulations and International Trade Manager for Mexico, also discussed current market conditions and opportunities for cooperation in the industry.

In total, seven remarkable seminars were hosted at the event, along with 16 presentations, no doubt the most popular being the 'Cooking and Tasting Yummy Seafood Show, which brought to attendees some lovely marine cuisine which proved extremely popular.

The Taiwan International Fisheries and Seafood Show will once again be held in 2020, and will no doubt be once again a great success in connecting people in the industry. Taiwan is now ranked the 21st country in terms of aquaculture processing and innovations, and it is clear that they are becoming a key location in the industry. The organisers, such as the Taiwan External Trade Development Council, My Exhibition and the Bureau of Foreign Trade, MOEA and The Kaohsiung City Government should be very proud of their achievements for the Taiwanese aquaculture sector.



Internet celebrities make live broadcasts at the indoor shrimp fishing experience



The "2019 World Aquaculture Techniques & Marketing Outlook" seminars received enthusiastic participation



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VIV Qingdao 2019, a successful show, China

VIV Qingdao 2019, held on 19–21st September, has come to an end and proved itself as a high-level international husbandry exhibition with an upgraded and renewed concept.

VIV Qingdao 2019 featured 451 companies from over 30 countries and regions in what was over 50,000 square meters of exhibit space. Altogether there were 20,257 visitors throughout the three-day show which was a 25 percent increase on VIV China 2018. Among them, there were 2315 international visits which increased by 13 percent compared to that of the previous edition.

Over 20 professional conferences and events were held onsite which attracted around 4439 visits. These activities not only enriched the content of the exhibition, but also provided more opportunities of interaction and sharing in the industry. VIV Qingdao 2019 invited more than 300 industry leaders together

with over 200 hosted buyers to the show and cooperated with 150 global media partners.

26 awarded innovative products were displayed in the InnovAction area in Hall S1 with speeches by the representatives of the awarded companies.

VIV Qingdao 2019 cooperated with Cargill to hold the conference theming at ASF prevention and control onsite the show. Tiger Quan, Commercial Director of Cargill Premix & Nutrition China gave a welcome speech. Richard Faris, Principal Scientist of Performance Innovation Team of Cargill Premix & Nutrition USA shared how Cargill prevents ASF, and also shared his advice on recuperation. The Grand Launch of Cargill's product "Reprofish/IPP/IGG" was also held onsite the event.

There were several delegations, both local and from abroad, visiting the show on the second day. VIV Qingdao 2019 arranged the guided tour and matchmaking for them. The delegations from large-scale enterprises, animal health industry, feed industry, etc. visited related exhibitor, and had business meetings.

The Animal Health Industry Analysis Forum, organised by ECHEMI and VNU Exhibitions Asia, focused on the industry trend in China, Europe, Southeast Asia and Middle East market. Around 30 international buyers participated in the forum. Guided tour around the show and matchmakings were arranged as well.

As the first edition of VIV 2.0 in China, VIV Qingdao 2019 has made a great success which set up a new mode of exhibition as well. With its pragmatic attitude and practical contents, the future of VIV in China is bright and promising.

VIV Qingdao 2020 will meet you from 17th to 19th in September, 2020. Gross exhibition area is 60,000m, there will be more than 700 exhibitors and 40,000 visitors. The booth fee would be a 10 percent off, when booking before December 31st, 2019.

Build my FeedMill at VIV Qingdao

International Aquafeed magazine were also very happy to announce that their latest rendition of the Build my FeedMill Conference, which took place at VIV Qingdao, was a great success.

Speakers from a variety of companies such as Famsun, PLP Liquid Systems, KSE, Andritz, Adifo, CPM and many more international companies joined the two-hour conference session to discuss the latest innovations for feed manufacturers.

The event was hosted by International Aquafeed's Publisher, Roger Gilbert and was available in both English and Chinese.

The next Build my FeedMill Conference will take place at VIV MEA in Abu Dhabi in early March 2020, (date to be confirmed) followed by Build my FeedMill at VICTAM and Animal Health and Nutrition Asia on march 25th, 2020 at BITEC, Bangkok.

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Yeast products

ICC, Adding Value to Nutrition
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www.iccbrazil.com

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www.lallemandanimalnutrition.com

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the interview

Dr Ricardo Ekway PhD, Vice President of Nutrition, Arbiom

Companies around the world are researching new solutions for the problem of creating sustainable protein sources for fish feed. Now Arbiom, a company located in France and the USA, is pioneering the use of protein derived from wood waste products.

As wood is a plentiful and renewable resource, the advantage of creating protein from a waste product are obvious. At the Aquaculture America 2019 show in New Orleans, Louisiana, we sat down with Arbiom's Dr Ekway to find out more about the company's progress with this ground-breaking new technology.

We first heard of Arbiom through a presentation given by one of your French colleagues at Aqua Innovation 2018 in London. Back then you were seeking investors. Where is your company now?

We continue to seek the right investment opportunities to help fuel our growth as we continue along the path toward commercialisation. We have, to date, been financed by a family office in Paris and they've continued their support. We are looking for additional partners, especially from within the feed industry.

Additionally, we are looking for consortiums that can span the entire life of this project from wood sourcing all the way to the production of fish feed. On that note, we recently joined an EU Horizon 2020 project called NextGen Proteins, where several alternative proteins will be evaluated for aquaculture, poultry and human food applications.

Can you tell me a little bit about wood waste sourcing?

Our goal is to partner with a pulp and paper mill where a significant portion of their product ends up as wood waste. The SYLFEED project, which Arbiom is leading, includes Norske Skog, a Norwegian pulp and paper company. Ultimately, we believe there are mature supply chains that will present a strong opportunity to partner. We have experience with different types of wood, including hard wood, soft wood and even general biomass, such as bagasse. A benefit of our expertise is that because we have a breadth of experience with feedstocks, we're able to fine-tune our process for a particular feedstock.

What are your biggest challenges to date?

It is critical that we expand the list of available protein sources. Currently, a significant amount of effort is going into reallocating existing resources toward the creation of protein and better-quality protein, but creating new protein is something that's harder to do and that's something this process is accomplishing. We're making the pie bigger by creating new protein.

Are you still running trials?

Yes, we have completed successful trials in hybrid striped bass and Atlantic salmon. You can find more specific information in the press releases attached, but highlights included successful replacement of plant and animal proteins, and a high protein digestibility (>97%). We are scheduled to run additional trials in Nile tilapia, rainbow trout, sea bass, and sea bream in the coming months.

What fish species have you used in field tests of your wood-derived feed?

We have conducted successful trials in Atlantic salmon and hybrid striped bass, and now we're kicking off tilapia. The results thus far have been highly promising.

How long before you come to market?

Our goal is to commercialise our product over the course of the next several years. We are working on a demonstration program to validate our technology on a larger scale. The aim of that is to produce several-hundred tonnes of material, both for internal trials and for customer trials, and to validate our process on a larger scale. Our goal is to be producing commercial quantities of material by 2022.

This is potentially a revolutionary solution

We do see a global impact—especially in protein-insecure areas. Not everyone has farmland to produce protein for themselves. We see this as a critical opportunity for them to establish a secure source of protein.

Any type of woody materials can be used. However, the idea is that we're not shipping wood around the world. We want this to be a simple solution, so we would use locations that have supply chains already in place. This is why we continue to seek the right partners to aid us in this journey.

Who are your biggest competitors?

Obviously, there's a lot of growth in the alternative protein market. Aquaculture and the world's population are both growing rapidly, so I think there's significant opportunity for multiple solutions to coexist and help solve the protein gap. We're looking forward to publishing the results of further trials, as well as data that validates the sustainability of our solution, in the weeks and months to come.



People

THE INDUSTRY FACES



Carlos Saviani

Carlos Saviani joins DSM for animal nutrition and health

Royal DSM, a global science company in Nutrition, Health and Sustainable Living, has announced the appointment of Carlos Saviani as Global Sustainability Lead for Animal Nutrition and Health. Mr Saviani will play a key role in the further development and rollout of the company's animal nutrition purpose-led sustainability strategy. He will focus on engagement with customers and associated stakeholders in the global animal protein value chain.

David Nickell, Vice President for Sustainability, Animal Nutrition and Health said, "I am pleased to welcome Carlos to our DSM Animal Nutrition and Health team. We have a growing pipeline of projects and are excited to have a new team member of Carlos' calibre join as we continue to drive our purpose-led sustainability strategy."

Carlos Saviani, Global Sustainability Lead, DSM said, "DSM's Animal Nutrition and Health is achieving great success in driving the organisation's purpose-led agenda. With the growing demand for animal proteins and the growing need to improve its sustainability, I am proud to join an organisation that places a key focus on sustainable animal production through innovative nutritional solutions and technologies."



Cory Harris

Cory Harris joins AFIA as manager of government affairs

The American Feed Industry Association has announced the addition of Cory Harris as its manager of government affairs as of effective September 16th 2019. Mr Harris will be responsible for managing the association's government affairs activities to ensure a high level of legislative representation and member advocacy.

He will also work closely with AFIA committees to keep them informed on legislative issues and AFIA's board of directors to plan advocacy and the annual fly-in.

"Cory brings several years of effective advocacy to the table as well as a passion to represent our industry," said Leah Wilkinson, AFIA's vice president of public policy and education.

"We are very excited to see where he takes AFIA's advocacy efforts and for him to join our legislative and regulatory team."

Mr Harris joined AFIA in September 2019 from the Indiana Soybean Alliance and Indiana Corn Growers Association where he led the day-to-day policy functions of grassroots membership organisations. Prior to that, he maintained relationships with congressional offices to conduct advocacy and membership for Growth Energy.



Hallvard Muri

AKVA CEO steps down

Mr Muri has recently left his post as CEO of AKVA. He thanked the company but said now was the right time to let someone else take on the challenge of developing AKVA further.

In a post on the Oslo Stock Exchange he stated, "After serving as CEO for three years, I believe it is time to pass on the leadership of AKVA, and let others take on the challenge developing AKVA further."

"AKVA is a great company with a strong position, and potential for the future. I would like to thank the Board of Directors, the management team and all the employees for the time I have had in the company, and I wish them all the best for the future."

Knut Nesse will resign from his current role to take up the post of interim CEO.



Lene Hogset

New Technical Manager joins MSD Animal Health

MSD Animal Health recently hired veterinarian Lene Hogset to join their team as Technical Manager. Hogset's previous work at Fishguard, as well as her experience working with salmon farmers first-hand motivated her to take the new role with MSD Animal Health.

"I want to help develop and improve the use of lice, vaccines and anaesthetics to optimise fish welfare and fish health," she said.

MSD Animal Health conducts research worldwide on salmon and a variety of other marine species. All research is managed from Bergen, Norway.

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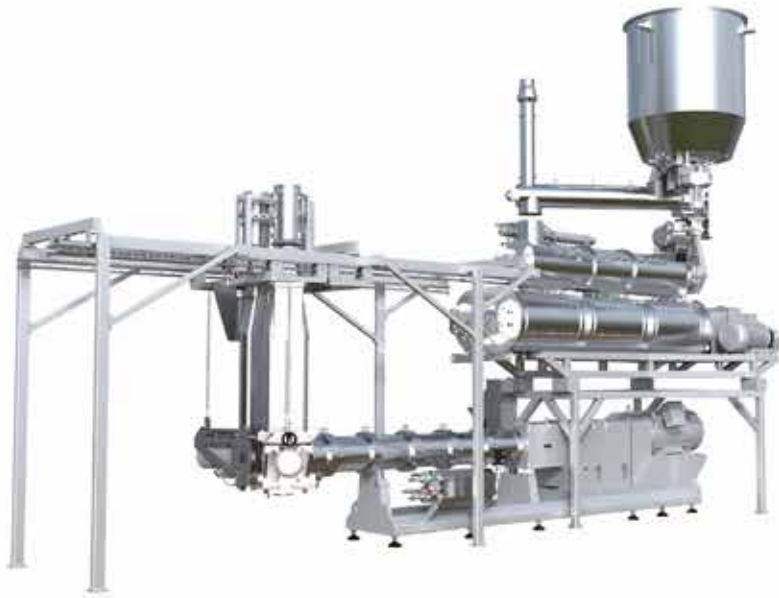
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