Ref. Ares(2018)3409856 - 27/06/2018

AQUA EXCEL 2020

AQUAculture infrastructures for EXCELlence in European fish research towards 2020 — AQUAEXCEL2020

D2.3a - Report on each of the brokerage events

AquaTT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652831. This publication reflects only the view of the author, and the European Commission cannot be held responsible for any use which may be made of the information contained therein

Executive Summary

Objective: The AQUAEXCEL[2020] industry brokerage events are aimed to create a forum for engagement and exchange between researchers and potential beneficiaries of the AQUAEXCEL[2020] research results, in particular industry stakeholders.

Rationale: Knowledge generated within the framework of the AQUAEXCEL[2020] project, both through the Transnational Access (TNA) programme, the Networking Activities (NA) and the Joint Research Activities (JRA), are communicated to the aquaculture industry community through the following parallel brokerage event activities: i) project catalogues (describing AQUAEXCEL[2020] knowledge OUTPUTs), ii) different types of presentations during the project industry brokerage events, and iii) an AQUAEXCEL[2020] exhibition booth at the Aquaculture Europe events with dedicated information on the project actions and results.

Knowledge OUTPUTS presented at the AQUAEXCEL[2020] industry brokerage events are selected by the project Industry and Research Advisory Panel (IRAP), as being high priority OUTPUTS for the aquaculture industry in Europe at present.

Main Results: The first AQUAEXCEL[2020] industry brokerage event "FROM RESEARCH INNOVATION TO INDUSTRY APPLICATION" was hosted as part of the EATiP industry day during the Aquaculture Europe 2017 conference in Dubrovnik (Croatia) on 19 Oct 2017, 14:30-17:30.

The event was divided into four parts: 1. Introduction to AQUAEXCEL[2020], 2. Selected (FP7-) AQUAEXCEL and AQUAEXCEL[2020] TNA OUTPUTS, 3. AQUAEXCEL[2020] activities of benefit to the aquaculture industry, and 4. What does the aquaculture industry in general expect from research?

The event was opened with a welcome by EATiP, followed by an introduction to the AQUAEXCEL[2020] project by its coordinator (Dr Marc Vandeputte, INRA). The TNA programme was introduced to the participants, together with an invitation to apply for access to one of the participating 39 aquaculture Research Infrastructures in Europe. Two presentations on 'Fostering Innovation from Research Infrastructures' introduced participants to the knowledge OUTPUT selection process as well as the IRAP and its role in AQUAEXCEL[2020].

The core part of the brokerage event consisted of three presentations on the selected knowledge OUTPUTS of high potential for transfer to the aquaculture industry. The topics of these knowledge OUTPUTS were: i) insect meal to feed juvenile sea bass, ii) a toolset to assess intestinal health benefits of feed additives, and iii) 3D fish monitoring system for aquaculture. The presenters of the knowledge OUTPUTS were instructed in advance of their presentations to ensure focus for an industry audience.

The third part of the event comprised presentations of work package leaders (or partners on their behalf) within AQUAEXCEL[2020] on: i) Standardisation and maintenance of fishlines, ii) Virtual laboratories and modelling tools for designing experiments in aquaculture research facilities, iii) Experimental Fish Management, and iv) New aquaculture training courses and an overview of the online European aquaculture facility directory.

The last event was opened by one of the AQUAEXCEL[2020] IRAP industry experts, Mr Kjell Maroni (FHF), with a presentation on "Perspectives from the Industry", followed by an industry

panel discussion. This discussion was moderated by Mr Courtney Hough (EATiP) and chaired by industry (Mr Kjell Maroni) and research (Dr Marc Vandeputte) experts.

54 people from 22 different countries attended the event, roughly 30% from private companies, 30% from universities, 30% from research institutes and 10% other (associations, European Commission). The gender balance was 36% women and 64% men.

Authors/Teams involved: Claudia Junge (AquaTT), Marieke Reuver (AquaTT), Catherine Pons (EATiP), Elin Kjørsvik (NTNU)

Table of Contents

Executive Summary 2
1 Introduction 5
2 Before the Event 5
3 The Brokerage Event 6
4 Feedback assessment 8
5 After the Event 9
6 Conclusion 10
7 Glossary 11
8 Annex 1 – Brokerage Event Flyer 12
9 Annex 2 – Project Catalogues (3) 14
10 Annex 3 – OUTPUT Presentation PowerPoint slides (3) 20
11 Document information 26
12 Annex 4: Check list 27

1 Introduction

The AQUAEXCEL2020 industry brokerage events are aimed to create a forum for engagement and exchange between researchers and potential beneficiaries of the research results, in particular industry stakeholders.

Knowledge generated within the framework of the AQUAEXCEL2020 project, both through the Transnational Access (TNA) programme, the Networking Activities (NA) and the Joint Research Activities (JRA), are communicated to the aquaculture industry community through the following parallel brokerage event activities: i) project catalogues (describing AQUAEXCEL2020 knowledge OUTPUTs), ii) different types of presentations during the project industry brokerage events, and iii) an AQUAEXCEL2020 exhibition booth at the Aquaculture Europe events with dedicated information on the project actions and results.

Knowledge OUTPUTS presented at the AQUAEXCEL2020 industry brokerage events are selected by the project Industry and Research Advisory Panel (IRAP), as being high potential OUTPUTS for the aquaculture industry in Europe at present.

Project catalogues are developed and disseminated for those high potential OUTPUTS. Researchers involved in the development of selected AQUAEXCEL2020 OUTPUTS are invited to the industry brokerage event along with selected work package leaders of AQUAEXCEL2020.

The first AQUAEXCEL2020 industry brokerage event “FROM RESEARCH INNOVATION TO INDUSTRY APPLICATION” was hosted as part of the EATiP industry day during the Aquaculture Europe 2017 conference in Dubrovnik (Croatia) on 19 Oct 2017, 14:30-17:30.

2 Before the Event

Preparation of the event

To ensure the AQUAEXCEL2020 industry brokerage event would be interesting for, and attract its core target audience, namely industry stakeholders, the organisers carefully devised the programme focusing on this audience.

Two separate PowerPoint presentation templates were developed for: 1) the knowledge OUTPUT presentations, and 2) the AQUAEXCEL2020 work package presentations and were provided to all presenters in advance of the event. The format for the latter was somewhat more flexible but included the request of an industry-friendly and very visual presentation without scientific jargon. The presentation template for the selected knowledge OUTPUTS consisted of a total of 13 slides with precise content instructions per slide targeted at an industry audience.

Promotion of the event

The event was promoted in advance via promotional flyers, targeted emails and social media to interested stakeholders in the aquaculture research and industry communities.

A promotional flyer was developed which contained the scope of the event as well as the entire programme (see Annex 1 and image below).

The brokerage event flyer was distributed via aquaculture research and industry stakeholder email lists (e.g. through EATiP, FEAP, EAS, AquaTT Training News) and social media as well as internally to AQUAEXCEL2020 partners with the request to share widely within their networks.

Project catalogues were developed for each knowledge OUTPUT that was presented at the brokerage event (see Annex 2). These 2-pagers contained the following sections: summary, knowledge need, potential impact, underlying science, results, end-users & potential applications, and status. They were printed and made available for participants of the brokerage event.

3 The Brokerage Event

The industry brokerage event "FROM RESEARCH INNOVATION TO INDUSTRY APPLICATION" was hosted as part of the EATiP industry day during the Aquaculture Europe 2017 conference in Dubrovnik (Croatia) on 19 Oct 2017, 14:30-17:30.

The event was divided into four parts: 1. Introduction to AQUAEXCEL2020, 2. Selected AQUAEXCEL (2020) TNA OUTPUTS, 3. AQUAEXCEL2020 activities of benefit to the aquaculture industry, and 4. What does the aquaculture industry in general expect from research?

The first part and the overall event were opened through a welcome by EATiP, followed by an introduction to the AQUAEXCEL2020 project by its coordinator (Dr Marc Vandeputte, INRA). Then, the TNA programme was introduced to the participants, together with a call to apply for access to one of the participating 39 Research Infrastructures in Europe. Two presentations

on 'Fostering Innovation from Research Infrastructures' introduced participants to the knowledge OUTPUT selection process as well as the IRAP and its role in AQUAEXCEL[2020].

The core part of the brokerage event consisted of three presentations on the selected knowledge OUTPUTS of high potential for transfer to the aquaculture industry on: i) insect meal to feed juvenile sea bass (by Prof. Laura Gasco, DISAFA, University of Turin, Italy), ii) a toolset to assess intestinal health benefits of feed additives (by Jaume Pérez-Sánchez, Nutrigenomics and Fish Growth Endocrinology Group, IATS-CSIC, Spain), and iii) 3D fish monitoring system for aquaculture (by Petr Císař, University of South Bohemia, FFPW, ICS). A PowerPoint presentation template consisting of a total of 13 slides with precise content instructions per slide targeted at an industry audience was provided to all presenters in advance of the event. The slides of the three OUTPUT presentations can be found in Annex 3.

Photo caption: OUTPUT Presentation by Prof. Laura Gasco, at the AQUAEXCEL[2020] first brokerage event in Dubrovnik (Croatia). ©AquaTT

The third part comprised four presentations of work package leaders (or partners on their behalf) within AQUAEXCEL[2020] on: i) Standardisation and maintenance of fishlines, ii) Virtual laboratories and modelling tools for designing experiments in aquaculture research facilities, iii) Experimental Fish Management, and iv) New aquaculture training courses and an overview of the online European aquaculture facility directory.

The fourth part was opened by one of the AQUAEXCEL[2020] IRAP industry experts, Mr Kjell Maroni (FHF), with a presentation on "Perspectives from the Industry", followed by an industry panel discussion. This discussion was moderated by Mr Courtney Hough (EATiP) and chaired by industry (Mr Kjell Maroni) and research (Dr Marc Vandeputte) experts.

Photo caption: Industry panel discussion, at the AQUAEXCEL2020 first brokerage event in Dubrovnik (Croatia). ©AquaTT

54 people from 22 different countries attended the event, roughly: 30% from Universities, 30% from research institutes, 30% from private companies and 10% other (associations, European Commission); 36% females and 64% males.

Photo caption: AQUAEXCEL2020 partners, IRAP industry experts, TNA knowledge OUTPUTS presenters and two of the participants at the AQUAEXCEL2020 brokerage event at Aquaculture Europe 2017 in Dubrovnik (Croatia), from left: Mr Erturul Gündoğdu (Nesne Elektronik), Mr Courtney Hough (EATiP), Dr Jaume Pérez-Sánchez (CSIC), Hilal T. Gündoğdu (Nesne Elektronik), Dr Åsa Espmark (Nofima), Dr Petr Císař (University of South Bohemia), Dr Marc Vandeputte (INRA), Ms Catherine Pons (EATiP), Mr Arnault Chaperon (Caviar Pirinea), Mr Kjell Maroni (FHF), Dr László Varadi (Hungarian Aquaculture Association), Dr Laura Gasco (University of Turin), Dr Fernando Torrent (Universidad Politécnica de Madrid), Ms Pavlina Pavlidou (Selonda SA), Ms Marieke Reuver (AquaTT). ©AquaTT

4 Feedback assessment

During the event, a real-time feedback survey was performed using “KAHOOT”. Participants were asked to log into an active online survey and answer a few general questions, questions related to the presented OUTPUTS as well as a few feedback questions regarding the scope and format of the event to ensure the best possible knowledge transfer strategy and success.

About half of the participants took part in the survey (around 40% females, almost 60% males), of those, over 50% were from research institutes or universities, almost 20% from private companies, almost 5% from SMEs, and over 20% stated “other”. 40% stated they were interested in marine cold-water species, Mediterranean species and freshwater species, whilst the remaining 60% were equally distributed across the three separate species groups.

Insect feed: Over 80% stated that insect meal as feed substitution is relevant to their research, work and/or company, and 65% found it beneficial for both marine and freshwater fish production. About 65% identified “renewable feed resource” as the most important outcome from using insect meal as a feed ingredient, and 15% and 20% indicated “improved fish welfare” and “more efficient production/lower cost”, respectively.

Toolset: Over 70% stated that the toolset to assess intestinal health is relevant to their research, work and/or company, and about 60% indicated all three given applications as important benefits from using such a toolset, i.e. “standardized testing of new additives”, “effective testing of many potential additives”, and “thorough testing through the multi-method approach”, and about 20%, 20% and 5% favoured each single application, respectively. Over 50% indicated that the main market for such a toolset would be “feed companies”, and about 20% each were allocated to “fish production companies” and “veterinarians and service supplying companies”.

3DFISH: Over 70% stated that 3DFISH to monitor fish is relevant to their research, work and/or company, with its main reason for implantation being “to improve fish welfare and health” (about 50%), followed by “to monitor productivity” (15%), “for economic benefits” (about 30%). Interesting scales for implementation were selected as “large scale sea cages” (about 50%), “small (indoor) scale” (over 30%), and “medium scale” (about 10%). Over 60% can see 3DFISH being implemented either within 3 years (about 40%) or in the long term, i.e. after 3 years (about 25%).

All OUTPUTS: Over half of all participants who took part in the survey found 3DFISH to be the most interesting OUTPUT for their research, work and/or company; over 30% selected the insect meal and about 15% the toolset. All participants believed that their preferred OUTPUT will be implemented commercially; over 10% believed this will be possible within a year, over 40% in less than 3 years, and about 45 % were not sure when exactly. 75% indicated that they would like to contact one of the speakers for further discussions, either during the coffee break, via email or scheduled meeting.

Event feedback: 96% found the format of the brokerage event and its presentations appropriate, and over 80% indicated that they are either “likely” (28%) or “very likely” (56%) to attend another AQUAEXCEL[2020] brokerage event in the future.

Further details of the KAHOOT survey results can be found in Deliverable D2.5 (Impact Analysis).

5 After the Event

All project catalogues from the OUTPUTS presented at the brokerage event are available online from the project’s website, here: www.aquaexcel2020.eu/about/results. This will contribute to the promotion of both the TNA and AQUAEXCEL[2020] research results on a wider level.

All knowledge OUTPUT presenters were requested to complete a feedback survey, which included the identification of additional end-users following the brokerage event, the description of follow-up discussions and interested stakeholders and possible future collaborations. The presenters indicated interest from people from the industry, researchers as well as representatives from the European Commission. Future collaborations/actions included feature articles, publications and discussions about spin-off companies.

The survey will be repeated every 12 months to monitor knowledge exploitation and transfer success.

6 Conclusion

The first AQUAEXCEL2020 industry brokerage event was successfully held on 19 October 2017, during the Aquaculture Europe 2017 conference in Dubrovnik (Croatia). The event was part of the EATiP industry day as it was considered to be an effective and relevant forum for engagement and exchange between researchers and potential beneficiaries of the AQUAEXCEL2020 research results, namely aquaculture industry stakeholders.

Knowledge generated within the framework of the AQUAEXCEL2020 project was communicated to the aquaculture industry community through means of presentations on selected Knowledge OUTPUTS. In addition, project catalogues (describing the AQUAEXCEL2020 knowledge OUTPUTs) were handed out and there was an AQUAEXCEL2020 exhibition booth at the Aquaculture Europe event with dedicated information on the project actions and results.

Knowledge OUTPUTS presented at the first AQUAEXCEL2020 industry brokerage event in Dubrovnik were selected by the project Industry and Research Advisory Panel (IRAP), as being high priority OUTPUTS for the aquaculture industry in Europe at present.

7 Glossary

AQUAEXCEL2020: AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020

8 Annex 1 – Brokerage Event Flyer

AQUA EXCEL 2020

AQUAculture Infrastructures for EXCELlence in European fish research towards 2020 – AQUAEXCEL2020

AQUAEXCEL2020 BROKERAGE EVENT

FROM RESEARCH INNOVATION TO INDUSTRY APPLICATION

Are you working in the European aquaculture industry, and would you like to hear about the latest innovative research findings which can be applied to the aquaculture industry?

Would you like to contribute to the discussion on what industry expects from aquaculture research?

Curious to know how you can access top-class European aquaculture research infrastructures to carry out your applied research, fully funded by the European Commission?

Join us at the AQUAEXCEL2020 brokerage event to engage with aquaculture industry stakeholders and researchers!

Thursday 19 October 2017, 14:30-17:30
at Aquaculture Europe 2017
Tajan room, VALAMAR Resort, Dubrovnik (Croatia)

This event, organised by EATiP and AquaTT, will create a forum for engagement and exchange between researchers and potential industry beneficiaries of the research results generated from the AQUAEXCEL2020 project and its precursor, the AQUAEXCEL project.

REGISTRATION

You are invited to register in advance by emailing **secretariat@eatip.eu** with your name and contact details, but participants are also welcome to join on the day. For more information visit **www.aquaexcel2020.eu** or say hello at the **AquaTT (no. 88/89)** or **EATiP (no. 67) booths** at Aquaculture Europe 2017.

European Aquaculture Technology and Innovation Platform

AQUATT

WWW.AQUAEXCEL2020.EU

AQUAEXCEL2020 BROKERAGE EVENT PROGRAMME

INTRODUCTION TO AQUAEXCEL2020	
14:30 - 14:35	**Welcome** Mr Courtney Hough (European Aquaculture Technology and Innovation Platform, EATiP)
14:35 - 14:40	**Introducing AQUAEXCEL2020 and its Relevance to the Aquaculture Industry** Dr Marc Vandeputte (Institut national de la recherche agronomique, INRA)
14:40 - 14:50	**Access to EU Aquaculture Research Infrastructures – the AQUAEXCEL2020 TNA Programme** TBC (On behalf of Mr John Bostock, the University of Stirling, UoS)
14:50 - 15:00	**Fostering Innovation from Research Infrastructures** • **The AQUAEXCEL2020 Knowledge OUTPUT Pathway to Industry Application** Dr Claudia Junge (AquaTT) • **The Industry & Research Advisory Panel (IRAP) and their Critical Role in AQUAEXCEL2020** Ms Catherine Pons (EATiP)
SELECTED AQUAEXCEL(2020) TNA OUTPUTS	
15:00 - 15:15	**Insect Meal to Feed Juvenile European Sea Bass** Dr Laura Gasco (University of Turin, UNITO)
15:15 - 15:30	**A Toolset to Assess Intestinal Health Benefits of Feed Additives** Dr Jaume Perez-Sánchez (Consejo Superior de Investigaciones Científicas, CSIC)
15:30 - 15:45	**3DFISH – 3D Fish Monitoring System for Aquaculture** Dr Petr Císař (University of South Bohemia, JU)
15:45 - 16:10	**COFFEE BREAK**
AQUAEXCEL2020 ACTIVITIES OF BENEFIT TO THE AQUACULTURE INDUSTRY	
16:10 - 16:45	**Standardisation and Maintenance of Fishlines** Dr Marc Vandeputte (INRA; on behalf of Dr Edwige Quillet, INRA) **Virtual Laboratories and Modelling Tools for Designing Experiments in Aquaculture Research Facilities** Dr Hans V. Bjelland (SINTEF Ocean AS; on behalf of Dr Gunnar Senneset, SINTEF Ocean AS) **Experimental Fish Management** Dr Åsa Espmark (Nofima) **New Aquaculture Training Courses and an Overview of the Online European Aquaculture Facility Directory** Ms Marieke Reuver (AquaTT)
WHAT DOES THE AQUACULTURE INDUSTRY IN GENERAL EXPECT FROM RESEARCH?	
16:45 - 16:55	**Perspectives from the Industry** Mr Kjell Maroni (Norwegian Seafood Research Fund, FHF)
16:55 - 17:25	**Industry Panel Discussion – Actions and Industry Interactions** Moderators: Mr Courtney Hough / Ms Catherine Pons (EATiP) Chairs: Mr Kjell Maroni (FHF) Dr Marc Vandeputte (INRA)
17:25 - 17:30	**Meeting close**

CONTACT US

Coordination: Marc.Vandeputte@inra.fr
IRAP & Brokerage: secretariat@eatip.eu
Project Management: Ronan.Pendu@inra.fr
Communication & Press: Marieke@aquatt.ie

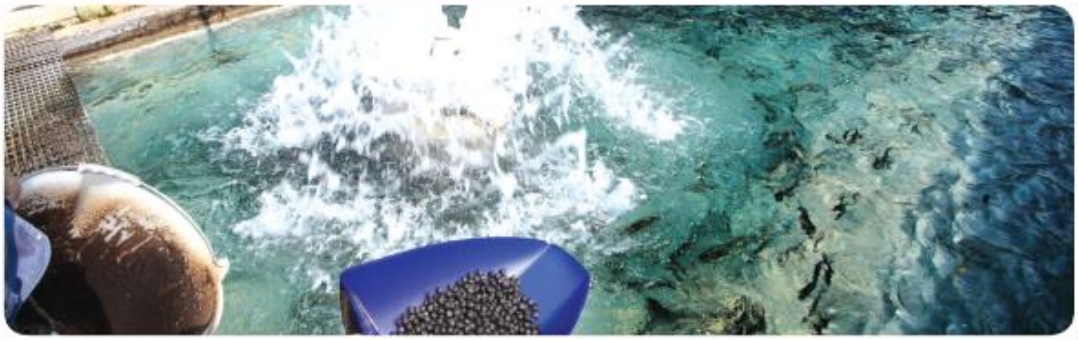
WWW.AQUAEXCEL2020.EU
@AQUAEXCEL2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 652831. This output reflects the views only of the author(s), and the European Union cannot be held responsible for any use which may be made of the information contained therein.

Designed & developed by AquaTT

9 Annex 2 – Project Catalogues (3)

INSECT MEAL AS SUSTAINABLE FEED FOR JUVENILE EUROPEAN SEA BASS



SUMMARY

This research investigated the effect of fish meal replacement by insect mealworms (*Tenebrio molito*) in the diet of European (sea) bass (*Dicentrarchus labrax*) juveniles. Results showed that substitution of 25% ensures normal growth performance and feed utilisation of the juveniles. This finding comes at an important time for the European aquaculture industry as the updated EU 'Novel Food' Regulation (EU 2015/2283 – new rules to be applied as of January 2018) opens the door for the use of insects as an innovative food source in aquaculture.

KNOWLEDGE NEED

Fish farmers rely on sustainable feed that can make fish strong and healthy. The aquaculture industry is looking for alternative feed sources because the supply of a key ingredient of fish feed found in fish meal and fish oil is limited. However, completely replacing these with a different feed source in the fish's diet can lead to adverse effects on the fish, for example decreased digestion efficiency and increased susceptibility to diseases and stress. Alternative fish feed sources with high biological value and low competitiveness with human food are needed, and their safe substitution levels must be established.

POTENTIAL IMPACT

- Substituting juvenile sea bass diets with mealworm meal reduces the need for fish meal and oil, which are costly, volatile and unsustainable sources. This could lead to a more sustainable and competitive aquaculture sector.
- The establishment of mealworms as a suitable feed substitution for juvenile basses opens the door for further research into its applicability for other aquaculture species.
- The findings contribute towards improving ecological and social sustainability of fish feeds, especially if applied to multiple species.
- Economically, the substitution with mealworms is expected to reduce the feeding costs in European aquaculture as mealworms are expected to be a cheaper resource than fish meal and oil.

EATiP - Strategic Research and Innovation Agenda (SRIA) Thematic Area 4 - Sustainable Feed Production: Goal 1 and Goal 2. To see the full list and descriptions of the thematic areas and goals, please visit: **bit.ly/2xJx1AX**

AQUAEXCEL2020 PROJECT CATALOGUE WWW.AQUAEXCEL2020.EU

UNDERLYING SCIENCE

Insects such as mealworms are natural food sources for many fish species. Farmed fish, fed with insect-based meals, are able to perform well, depending on the level of substitution. In this study, three levels of substitution of fish meal by mealworm were applied to the diet of juvenile sea bass: 0% (control group), 25% and 50%. The experimental trial lasted 70 days and three replicates were performed per diet, each containing 50 fish.

The following performance and functions were monitored: initial and final body weight (individual and total biomass); percentage mortality; weight gain; feed consumption and feed conversion rate; specific growth rate; protein efficiency ratio; and whole body composition (proximate analyses and fatty acids profile).

RESULTS

- **Substituting 25% of the diet with mealworms did not lead to adverse effects** on weight gain or changes in fatty acid composition.
- **Some negative effects were seen at the 50% substitution level**, with significant growth reduction, less favourable outcomes for specific growth rate and feed consumption ratio, as well as a change in fatty acid composition, particularly a decrease in the contents of omega-3 fatty acids.
- Protein efficiency ratio and feed consumption were **not affected** by either level of substitution.
- The whole-body proximate composition analysis **did not show any differences** between treatments.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Aquaculture fish feed producers
APPLICATION: Developing and producing novel feed formulations based on alternative, safe and sustainable feed sources (like mealworms) with high biological value and low competitiveness with human nutrition.

END-USER 2: Aquaculture fish farmers
APPLICATION: Feeding of aquaculture fish stocks with cheaper and more sustainable fish feeds while keeping good production levels, leading to higher profits and reduced impact on the environment.

END-USER 3: Aquaculture marketing and lobby groups
APPLICATION: Promoting aquaculture as a sustainable, dynamic sector, working towards improving global food security while decreasing environmental impact.

END-USER 4: Scientific Community
APPLICATION: Furthering knowledge relating to fish meal replacement and its effect on many aspects (such as growth, health, taste of the final product, etc.), in both sea bass juveniles, adults and other fish species. This will support development of the aquaculture sector and contribute to increased levels of Technology Readiness, and progression towards commercialisation.

STATUS

Technology Readiness Level (TRL) 4 - the knowledge has been validated in a laboratory environment.

Further research is needed to:

- Establish the precise optimal *Tenebrio* substitution rate in juvenile sea bass diets
- Investigate further effects of the *Tenebrio* diet substitution on other crucial elements such as digestive organs and their tissues, microbiota composition
- Understand changes in susceptibility to stressors under different diet compositions
- Explore suitability for other species and/or life stages
- Examine potential effects on the fish product, e.g. on texture, odour and taste
- Perform feeding trials on a commercial scale (i.e. validated and demonstrated in an industrially relevant environment)

AT A GLANCE

TITLE: Insect Meal as Sustainable Feed for Juvenile European Sea Bass
KNOWLEDGE TYPE: Scientific publication
WHERE TO FIND IT: Gasco *et al.* 2016. Animal Feed Science and Technology 220, 34-45
STATUS: Published
TNA FACILITY USED: Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC), Hellenic Center for Marine Research, Heraklion, Crete, Greece
CONTACT DETAILS: Dr Laura Gasco, DISAFA, University of Turin, Italy; laura.Gasco@unito.it
PATENTS OR OTHER IPR EXPLOITATIONS: No

Designed and developed by AquaTT

A TOOLSET TO ASSESS INTESTINAL HEALTH BENEFITS OF FEED ADDITIVES

© Jaume Pérez-Sánchez (IATS-CSIC)

SUMMARY

A toolset was developed to evaluate the effects of adding an organic acid salt to high plant-ingredient substituted diets of gilthead sea bream to alleviate some of the detrimental effects of replacing fish meal and fish oil. The toolset was tested and validated using sodium butyrate, one of the most promising feed additives to be used in aquaculture. The tools and intestinal health testing approach can be adapted for other species and feed additives in development.

KNOWLEDGE NEED

Plant-based fish food is seen as more sustainable than that containing fish meal and fish oil. While some farmed fish species can survive without any or with a very limited supply of marine feed ingredients, they can suffer from detrimental effects such as decreased efficiency to digest food and increased susceptibility to diseases and stress. Feed additives that improve health and nutrition of farmed fish and lessen intestinal inflammation induced by plant-based ingredients are therefore needed.

© Jaume Pérez-Sánchez (IATS-CSIC)

POTENTIAL IMPACT

- Use of the developed toolset will help with the understanding and assessment of the benefits of a feed additive, such as sodium butyrate, to a plant-based diet. As a simple "treatment" it can act as a first line of defence against diseases, improving health and welfare of gilthead sea bream fed on high plant-ingredient substituted diets.
- Similar positive effects could be assessed by making use of the toolset for a variety of other aquaculture species fed on similar diets when supplementing with sodium butyrate.
- The toolset will allow a better understanding of overall fish intestinal health as a result of a modified diet by providing more insight into the involved processes and dynamics.

EATiP - Strategic Research and Innovation Agenda (SRIA): Thematic Area 4 – Sustainable Feed Production; Goal 3, Thematic Area 7 – Aquatic Animal Health and Welfare; Goal 4. To see the full list and descriptions of the thematic areas and goals, please visit: **bit.ly/2xjx1AX**

AQUAEXCEL2020 PROJECT CATALOGUE WWW.AQUAEXCEL2020.EU

UNDERLYING SCIENCE

Feeding experiments were conducted, all using the same dose of sodium butyrate supplementation (i.e. 0.4% BP-70 ®NOREL), applied to four different diets: a control diet containing 25% fish meal and three experimental plant-based diets containing only 5% fish meal and different levels of fish oil. The effects of these dietary changes were studied using the following toolset:

- Blood biochemical (Haemoglobin concentration)
- Histological
- Immunohistochemical
- Molecular (gene expression)
- Electrophysiological (trans-epithelial electrical resistance)

RESULTS

The toolset applied provided evidence that the plant-based diets had significant negative consequences on factors related to growth, immune-response, inflammation and defence against disease overall. In addition, the toolset also showed that with the addition of the sodium butyrate additive most of these modifications were returned to normal values. These results confirmed the **potential of the combined toolset used in the experiment to verify that a given additive can improve or reverse the detrimental effects of fish diet formulations** using a high plant replacement of fish meal and oil.

The tools and the intestinal health testing approach developed in this research and current studies can be used as a toolset for other species and for testing candidate feed additives or improving those already existing.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Aquaculture feed producers
APPLICATION: The same histochemical, molecular, immunohistochemical, and electrophysiological toolset could be used to test the effect of plant-based diets and alternative feed additives.

END-USER 2: Aquaculture fish farmers
APPLICATION: The potential of an additive as a "treatment" can be tested in different aquaculture species or when disease risk in the production cycle is highest.

END-USER 3: Fish physiologists and pathologists (scientific community)
APPLICATION: The toolset will further investigations of the changes in intestinal health due to diet, infections and feed additives, to understand the fundamental processes across different species.

STATUS

Technology Readiness Level (TRL) 4 - the proof of concept has been successful on sea bream and butyrate under laboratory conditions.

Next steps include:

- Streamlining the toolset by optimisation e.g. inflammation assay, and reducing the test genes from 86 to the 20 most informative and reliable genes
- Investigating if the toolset can be extended to detect changes in the mucus protein and bacteria composition in a routine manner in the digestive system as a response to feed additives
- Understanding how these functional features are modified by genetic and epigenetic factors to establish a powerful model for the development of sustainable and heathy fish feeds
- Testing and validation of the toolset for different feed additives and species to confirm its universal applicability

AT A GLANCE

TITLE: A Toolset to Assess Intestinal Health Benefits of Feed Additives
KNOWLEDGE TYPE: Peer-reviewed publication
WHERE TO FIND IT: Estensoro *et al.* 2016. PlosOne 11(11): e0166564
STATUS: Published
TNA FACILITY USED: Institute of Aquaculture Torre de la sal (IATS-CSIC), Castellón, Spain; IATS-ANA (analytical), IATS-EXP (experimental)
CONTACT DETAILS: Dr Jaume Pérez-Sánchez, Nutrigenomics and Fish Endocrinology Group, IATS-CSIC, Spain; jaime.perez.sanchez@csic.es
PATENTS OR OTHER IPR EXPLOITATIONS: No

Designed and developed by AquaTT

AQUAEXCEL2020 PROJECT CATALOGUE WWW.AQUAEXCEL2020.EU

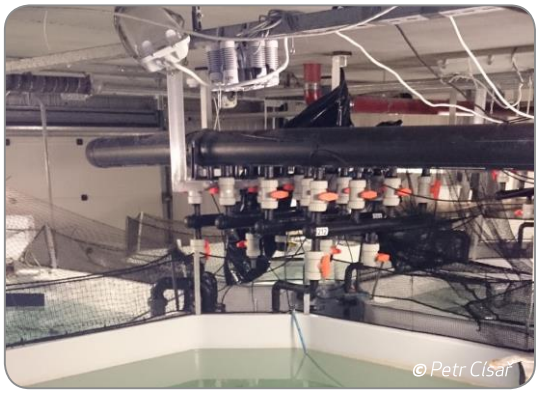
3DFISH – 3D FISH MONITORING SYSTEM FOR AQUACULTURE

SUMMARY

A novel infrared (IR) reflection system was developed for use as a suitable real-time 3D fish monitoring and measuring technique. The 3DFISH system is an inexpensive solution for real-time fish behaviour monitoring at indoor aquaculture facilities, and can also estimate fish weight. This will be of interest to aquaculture facilities looking to implement new 3D fish monitoring and measuring techniques or to improve upon existing techniques.

KNOWLEDGE NEED

Fish behaviour analysis can be used to address many questions related to nutrition, welfare, health and pathology, environmental interaction and aquaculture systems design. The basis of fish behaviour analysis is determining fish position and orientation at a particular time (called tracking). The automated analysis of fish tracks can provide information about individual fish behaviour, interaction and school behaviour, which can be used to monitor fish feeding activity and water quality, as well as enabling continuous contactless fish sampling. Existing technologies like 2D, single camera setups and stereo vision require either manual data analysis or are computationally intensive, causing problems with automated data processing.



POTENTIAL IMPACT

- 3DFISH enables non-invasive monitoring of fish behaviour and welfare indicators in real-time which allows for an efficient and cost-effective detection of behavioural abnormalities.
- Users of 3DFISH can detect potential problems in aquaculture facilities such as poor water quality and early disease signs earlier than in conventional systems, which will help reduce financial losses.
- The automated 3DFISH monitoring system requires less human labour, resulting in less human errors and higher profits.
- 3DFISH supports improved fish welfare because the fish do not need to be handled manually.

EATiP – Strategic Research and Innovation Agenda (SRIA) Thematic Area 2 - Technology & Systems; Goal 4, Thematic Area 7 - Aquatic Animal Health & Welfare; Goal 4. To see the full list and descriptions of the thematic areas and goals, please visit: **bit.ly/2xjx1AX**

UNDERLYING SCIENCE

Several approaches exist for fish detection and tracking. In this study, three systems for the monitoring of fish behaviour in 3D have been compared and evaluated: stereo vision, structured light and the novel 3DFISH infrared (IR) reflection.

Each fish monitoring technique was tested with the following parameters:

- Octahedron shape fish tank with fresh water (0.83m x 2m)
- All cameras and light sources were placed in a horizontal plane 1.21m above the water level near the central axis of the tank
- The experiments were conducted using Atlantic salmon with lengths 29.5±2.5cm and weight 295±73g

RESULTS

- All three systems reviewed have approximately the same horizontal plane accuracy of 0.5cm which depends on camera resolution and image segmentation algorithms.
- The stereo vision based system showed the best accuracy, but it requires two cameras and high computational power for detection of the stereo pairs in both views.
- The maximum obtained monitoring depth for the IR reflection system was ~75cm at 10 frames per second.

The **IR reflection system is recommended in circumstances where high accuracy of 3D coordinates calculation is not required, as is the case for fish tracking**. It uses an external light source with a wavelength which is highly absorbed by water. The advantages of this system include the low price of the components and relatively low required computation power. Increase of the monitored water volume can be obtained by using a more powerful external illuminator.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Aquaculture fish farmers
APPLICATION: Non-invasive monitoring of fish behaviour and various welfare indicators. If changes are seen, conditions can be reviewed and a veterinarian can be notified at an early stage of a problem. Furthermore, this real-time monitoring can aid in optimising feeding conditions, and allow for targeted fish sampling.

END-USER 2: Aquaculture veterinarians
APPLICATION: If an abnormal change in behaviour has been detected, veterinarians can investigate recordings and begin treatment much earlier if needed.

END-USER 3: Water treatment stations
APPLICATION: Water quality can be monitored indirectly through fish behaviour.

END-USER 4: Scientific community
APPLICATION: Researchers studying fish behaviour will be able to monitor any behavioural changes in real-time, for example in response to introduced stressors or alternative feeds.

STATUS

Technology Readiness Level (TRL) 6 - with respect to the fish weight estimation.

Next steps include:

- Redesigning the prototype for 24/7 usage
- Reimplementing the software to improve user interface

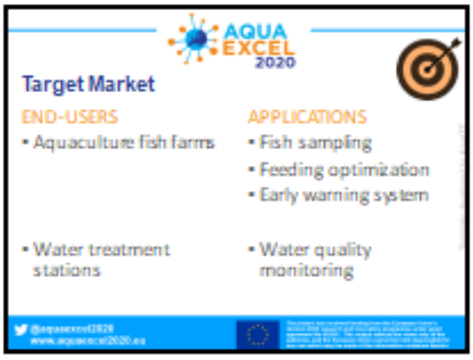
AT A GLANCE

TITLE: 3DFISH Monitoring System for Aquaculture
KNOWLEDGE TYPE: Peer-reviewed publication
WHERE TO FIND IT: Pausina *et al.* 2015. Aquacultural Engineering 69, 7–17
STATUS: Published, constant improvements and extensions of applications
TNA FACILITY USED: Nofima Centre for Recirculation in Aquaculture (Nofirma NCRA), Sunndalsøra, Norway
CONTACT DETAILS: Dr Petr Císař, University of South Bohemia, Czech Republic, cisar@frov.jcu.cz
PATENTS OR OTHER IPR EXPLOITATIONS: Software: protected by copyright; Hardware: a license for selling the system is planned

Designed and developed by AquaTT

10 Annex 3 – OUTPUT Presentation PowerPoint slides (3)

OUTPUT presentation #1:



Economic Impact

- Fish production increase
- Reduction of feeding costs
- Reduction of fish losses due to technology failure
- Reduction of manual fish monitoring and fish sampling

Intellectual Property (IP)

- The system is described in the published paper
- The software is protected by copyright right
- The licence for the system is planned

Current Status & Accomplishments

STATUS

- TRL 6 – the system used for fish weight estimation
- The prototype has to be redesigned for 24/7 usage
- The software has to be reimplemented – improve user interface

TIMELINE

- 6 months

Go to Market Plan

HOW TO COMMERCIALISE

- Automatic system
  - 3D monitoring system
  - Specific software modules
    - Early warning
    - Activity analysis
    - Fish sampling

PARTNERS NEEDED

- Fish farm – system re-design and final evaluation
- Aquaculture technology company – system distribution

Management Team

EXISTING EXPERTISE

- Software implementation
- Hardware design

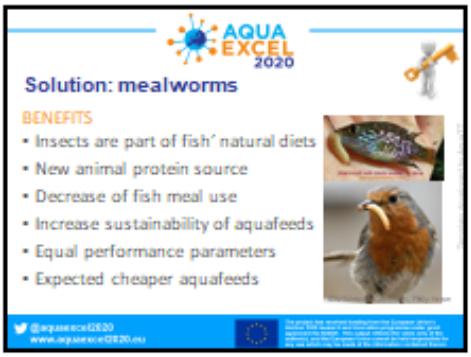
WANTED EXPERTISE

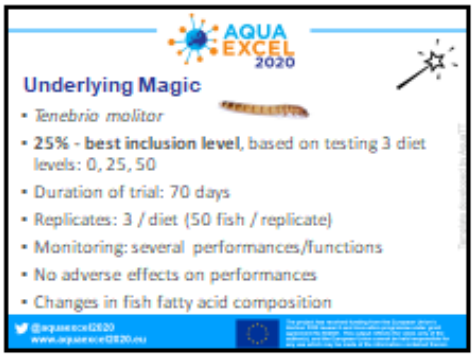
- Fish cultivation
- Aquaculture IT product selling

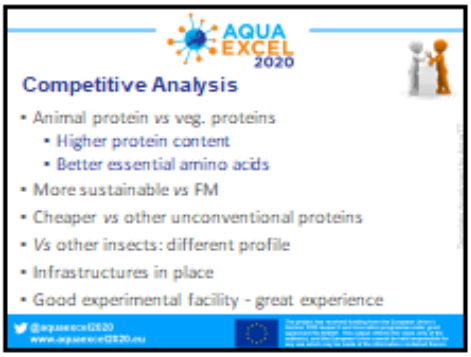
TNA Facility

- Nofima – NCRA, Sunndalsøra, Norway
  - Recirculation tanks
  - Atlantic salmon

OUTPUT presentation #2:







AQUA EXCEL 2020

Insect Meal as Sustainable Feed for Juvenile European Sea Bass

AQUAEXCEL2020 brokerage event
19 Oct 2017
Aquaculture Europe 2017

Prof. Laura Gasco, DISAFA, University of Turin, Italy

Industry Need

- EU: protein deficit (70% reliance on import)
- **New sustainable protein** sources with high biological value and low competitiveness with FOOD for AQUAFEEDS

Solution: mealworms

BENEFITS

- Insects are part of fish' natural diets
- New animal protein source
- Decrease of fish meal use
- Increase sustainability of aquafeeds
- Equal performance parameters
- Expected cheaper aquafeeds

Underlying Magic

- *Tenebrio molitor*
- **25% - best inclusion level**, based on testing 3 diet levels: 0, 25, 50
- Duration of trial: 70 days
- Replicates: 3 / diet (50 fish / replicate)
- Monitoring: several performances/functions
- No adverse effects on performances
- Changes in fish fatty acid composition

Competitive Analysis

- Animal protein *vs* veg. proteins
  - Higher protein content
  - Better essential amino acids
- More sustainable *vs* FM
- Cheaper *vs* other unconventional proteins
- *Vs* other insects: different profile
- Infrastructures in place
- Good experimental facility - great experience

Target Market

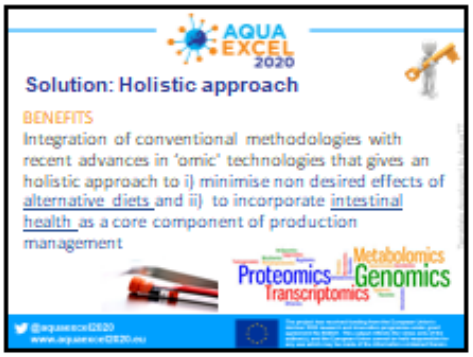
END-USERS

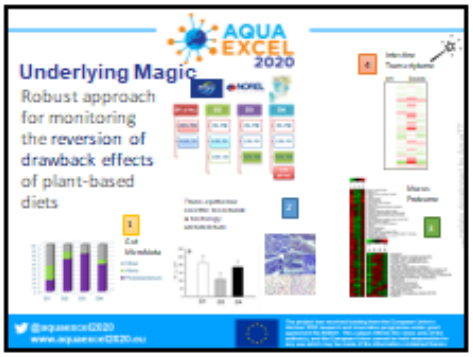
- Aquafeed industry
- Fish farmers

APPLICATIONS

- New feed formula
- Competitive & Sustainable European feed-related R&D projects
- Cheaper & more sustainable fish feeds

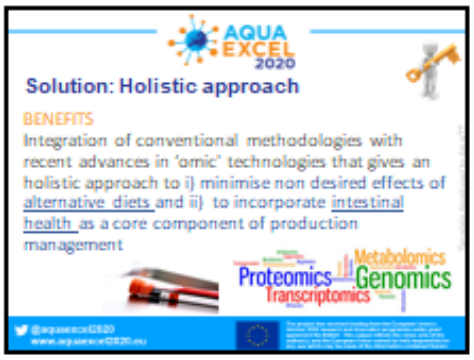
OUTPUT presentation #3:

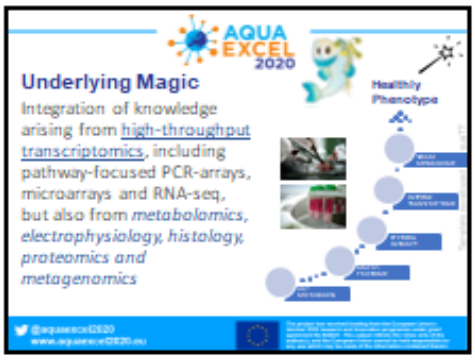


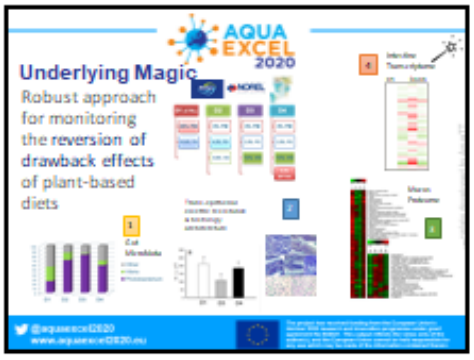


AQUA EXCEL 2020
Toolset for validating the utility of feed additives to improve intestinal health
AQUAEXCEL2020 brokerage event
19 Oct 2017
Aquaculture Europe 2017
Jaume Pérez-Sánchez, Nutrigenomics and Fish Growth Endocrinology Group, IATS-CSIC, Spain
www.nutrigroup-iats.org
CSIC

AQUA EXCEL 2020
Industry Need
There is a constant need to find feed additives that improve health and nutrition of farmed fish and lessen the intestinal inflammation induced by plant products or other alternative ingredients


AQUA EXCEL 2020
Solution: Holistic approach
BENEFITS
Integration of conventional methodologies with recent advances in 'omic' technologies that gives an holistic approach to i) minimise non desired effects of alternative diets and ii) to incorporate intestinal health as a core component of production management
Metabolomics
Proteomics
Genomics
Transcriptomics


AQUA EXCEL 2020
Underlying Magic
Integration of knowledge arising from high-throughput transcriptomics, including pathway-focused PCR-arrays, microarrays and RNA-seq, but also from metabolomics, electrophysiology, histology, proteomics and metagenomics
Healthy Phenotype


AQUA EXCEL 2020
Underlying Magic
Robust approach for monitoring the reversion of drawback effects of plant-based diets

AQUA EXCEL 2020
Competitive Analysis
• The toolset is supported by powerful genomic resources in sea bream and secondly sea bass (www.nutrigroup-iats.org)
• Long-term expertise on physiology, nutrigenomics and pathology allow us to fill the gaps on fish biomarker research, combining massive with targeted approaches "ALL in ONE"
AQUA EXCEL
ARRAINA
ParaFishControl
PerformFISH

11 Document information

EU Project N°	652831	**Acronym**	AQUAEXCEL[2020]
Full Title	AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020		
Project website	www.aquaexcel.eu		

Deliverable	**N°**	D2.3	**Title**	Report on each of the brokerage events
Work Package	**N°**	2	**Title**	NA2 – Fostering Innovation from RIs

Date of delivery	**Contractual**	30/09/2017 (Month 24)	**Actual**	27/06/2018 (Month 33)
Dissemination level	X	**PU Public, fully open, e.g. web**		
		CO Confidential, restricted under conditions set out in Model Grant Agreement		
		CI Classified, information as referred to in Commission Decision 2001/844/EC.		

Authors (Partner)	AquaTT, EATiP, NTNU			
Responsible Author	**Name**	Claudia Junge (AquaTT), Marieke Reuver (AquaTT)	**Email**	claudia@aquatt.ie; marieke@aquatt.ie

Version log			
Issue Date	**Revision N°**	**Author**	**Change**
dd/mm/yyyy			Ex: first version/first review by WP leader etc/accepted version

12 Annex 4: Check list

Deliverable Check list (to be checked by the "Deliverable leader")

	Check list		Comments
BEFORE	I have checked the due date and have planned completion in due time		*Please inform Management Team of any foreseen delays*
	The title corresponds to the title in the DOW		*If not please inform the Management Team with justification*
	The dissemination level corresponds to that indicated in the DOW		
	The contributors (authors) correspond to those indicated in the DOW		
	The Table of Contents has been validated with the Activity Leader		*Please validate the Table of Content with your Activity Leader before drafting the deliverable*
	I am using the AQUAEXCEL2020 deliverable template (title page, styles etc)		*Available in "Useful Documents" on the collaborative workspace*
The draft is ready			
AFTER	I have written a good summary at the beginning of the Deliverable		*A 1-2 pages maximum summary is mandatory (not formal but informative on the content of the Deliverable)*
	The deliverable has been reviewed by all contributors (authors)		*Make sure all contributors have reviewed and approved the final version of the deliverable. You should leave sufficient time for this validation.*
	I have done a spell check and had the English verified		
	I have sent the final version to the WP Leader, to the 2nd Reviewer and to the Project coordinator (cc to the project manager) for approval		*Send the final draft to your WP Leader, the 2nd Reviewer and the coordinator with cc to the project manager on the 1st day of the due month and leave 2 weeks for feedback. Inform the reviewers of the changes (if any) you have made to address their comments. Once validated by the 2 reviewers and the coordinator, send the final version to the Project Manager who will then submit it to the EC.*