



BlueBio COFUND – Training Course “Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams” – Activity Report



Image by NTNU

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## 1. Introduction

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The advanced training course entitled “Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams” was co-organised by the National Research Council (CNR Italy) and the Norwegian University of Science and Technology (NTNU, Norway), in the framework of the BlueBio ERA-NET Cofund. The course was held on 24-26 October 2023, hosted by the NTNU, Department of Biological Sciences Ålesund, Norway.

This report provides an analysis of the activities, including contents and process. It addresses methodology approaches as well as its format. Lessons learned, concluding remarks and follow-up opportunities are also tackled in this Activity Report.



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## 2. Implemented actions

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### 2.1. Timeline

Item	Deadline
Modality of the course, date, teachers program, target.	Draft of program and agenda to the BlueBio Executive Team by 11 <sup>th</sup> of April 2023
Call, Application form, criteria (DRAFT)	29 <sup>th</sup> of May 2023
Announcement	31 <sup>st</sup> of May 2023
Deadline for submission	Firstly planned on 25 <sup>th</sup> of June – postponed to 31 <sup>st</sup> of August 2023
Selection process	Firstly planned starting from 30 <sup>th</sup> of June 2023 – postponed to 4 <sup>th</sup> of September 2023
Disclosure of the selected students	14 <sup>th</sup> of September 2023
Training course	24 <sup>th</sup> -26 <sup>th</sup> of October 2023

### 2.2. The concept

The Blue Bioeconomy, as a part of the overall EU Bioeconomy Strategy and Circular Economy Package, offers great potential for the sustainable use of underexploited resources and connects, directly or indirectly, several sectors (e.g., fisheries, aquaculture, energy, tourism, conservation, etc.). However, the links between ocean health, impacts on resources and Blue Bioeconomy sectors still represent one of the knowledge gaps to be overcome for a "sustainable ocean economy", as recognized by the UN-Decade of Ocean Science for Sustainable Development<sup>1</sup>.

In line with this evidence, within the EU context, the main aim of the BlueBio ERA-NET Cofund project "Unlocking the Potential of Aquatic Bioresources" ([www.bluebio.eu](http://www.bluebio.eu)) has been to establish a coordinated R&D funding scheme for strengthening Europe's position in the Blue Bioeconomy, identifying new and improving existing ways of bringing bio-based products and services to the market. To fill knowledge gaps at the crossroads of biotechnology, food production, and sustainable use of bio-resources is recognized as crucial

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<sup>1</sup> UNESCO-IOC (2021). The United Nations Decade of Ocean Science for Sustainable Development (2021-2030) Implementation Plan. UNESCO, Paris (IOC Ocean Decade Series, 20.)



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for pursuing a sustainable exploitation of marine bio-resources and/or biomasses, considering socioeconomic impacts in several fields.

In order to support the implementation of the Blue Bioeconomy, the Strategic Agenda developed in the framework of the EuroMarine Consortium Working Group on “Enhancement of Human Resources to support Blue Growth sectors” (EHUSEA)<sup>2</sup> highlighted the importance of training experts in marine biotechnologies applied to different sectors (e.g., aquaculture, fisheries, seafood processing) and also identified the BlueBio ERA-NET funders’ network as a potential key player able to foster and develop tools for the implementation of actions targeting human resources. In addition, training the new generation of marine biotechnologists is also among the recommended activities in support of the UN-Decade of Ocean Science for Sustainable Development<sup>3</sup>.

Considering the relevance of Human Capacity Building (HCB) enhancement for the development of the Blue Bioeconomy, in March 2021 a first “Integrated advanced training course on Blue Biotechnologies, Aquatic products and Blue Bio-economy”<sup>4</sup> was jointly organized in the framework of the BlueBio ERA-NET Cofund and the BlueMed Coordination and Support Action (CSA) project, hosted in Messina (Italy) by the National Research Council of Italy. Due to the pandemic limitation to in-person events, this BlueBio initiative was held online, with very good feedback from the participants with regards to the organisational aspects, the interest for the topics tackled, the stimulating and inspiring atmosphere and finally the improved knowledge and skills.

In April 2022 an online e-coffee meeting on HCB was organized within BlueBio Task 7.3 (Annex 1), with the main objective of further promoting HCB within the network of BlueBio co-funded projects and identifying different forms of assistance that BlueBio ERA-NET Cofund could deliver (e.g., support for the organisation of training courses, workshops, webinars, etc.), taking into account their needs and starting from the opinions expressed by the project coordinators in reply to specific questions embedded in an online survey on HCB (the summary of responses is given in Annex 2).

The outputs highlighted the interest for specialised trainings on a few specific issues: “Valorisation of side streams in fisheries/aquaculture” and/or “end-products derived from algal cultivation” (from production to commercialisation). Therefore, considering that the above cited topics are strictly linked each other, as they both deal with the potential use of underexploited biological resources, the final proposal from Task 7.3 was in support of the organisation of a joint training course, able to deliver the relevant horizontal information

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<sup>2</sup> EuroMarine Strategic Agenda on Enhancement of Human Resources to support Blue Growth sectors, euromarinetwork.eu/EHUSEA\_Strategic\_Agenda;ISSN2239-51;; [https://dta.cnr.it/wp-content/uploads/2020/07/2019-28\\_EuroMarine\\_EHUSEA-Strategic-Agenda\\_v2.pdf](https://dta.cnr.it/wp-content/uploads/2020/07/2019-28_EuroMarine_EHUSEA-Strategic-Agenda_v2.pdf)

<sup>3</sup> European Marine Board (2019). Navigating the Future V: Recommendations for the Ocean Decade. EMB Policy Brief N°. 6, September 2019. ISSN: 0778-3590. ISBN: 978-94-92043-77-1. DOI:10.5281/zenodo.3465570

<sup>4</sup> <https://publications.cnr.it/doc/454397>; <https://dta.cnr.it/dta-34-2021-bluebio-cofund-bluedmed-csa-integrated-advanced-training-course-on-blue-biotechnologies-aquatic-products-and-blue-bio-economy-activity-report/>



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about the bio-refinery of organic biomass and to explore the specific issues by the contributions of experts at international level, with relevant examples of technology transfer from research to the industrial sector.

The above mentioned goals were firstly addressed by a specialised BlueBio Training Course entitled “Blue Bio-refinery technologies: from research to the industry with applications on products and biomaterial from algal biomass and sidestreams of fisheries and aquaculture”<sup>5</sup>, co-organized by the Italian CNR and University of Foggia and held in January 2023, with a BlueBio budget of 25 k€ and the additional financial support by the CNR Department of Earth System Sciences and Environmental Technologies (<https://dta.cnr.it/en/>) and UNIFG (about 5 k€ each).

The positive feedbacks received from the attendance of the first specialised BlueBio training course hosted by the University of Foggia prompted the BlueBio coordination to suggest a new edition of the course, more strictly focused on the bio-refinery of fishery and aquaculture sidestreams. This course was held in Ålesund (Norway) at the premises of NTNU University on 24-26 October 2023.

### **General rationale, objectives of the course and target**

In order to encourage Europe to assume a leadership position in the implementation of the Blue Bioeconomy, the course intended to further cover gaps on the education of professionals who can facilitate the progress along the pipeline towards the market, with special emphasis on bio-refinery technologies applied to the utilisation of sidestreams from fisheries and aquaculture. With this aim, the program was designed to increase awareness about advanced technologies, identifying bottlenecks hindering research-to-market progress, and explore solutions step by step. This objective was intended to be fostered through a practical approach that focused on multiple aspects and case studies.

The course was also designed to facilitate interaction with stakeholders and end-users, fostering effective bidirectional knowledge and technology transfer throughout the production chain.

### **Specific objectives for the attendance of the course:**

- 1) *Be aware of the significance of Biorefinery concept*
- 2) *Know the application fields, tools and opportunities.*
- 3) *Know the limits and identify overcoming strategies (e.g. available infrastructures).*
- 4) *Identify intra/interdisciplinary interaction strategies.*
- 5) *Know examples of best practices related to real-life experiences.*
- 6) *Be aware of the global market on sidestreams of fisheries and development trends.*
- 7) *Identify internship opportunities with industrial partners based on the products and services available.*

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<sup>5</sup> <https://dta.cnr.it/dta-44-2023-bluebio-cofund-training-course-blue-bio-refinery-technologies-from-research-to-the-industry-with-applications-on-products-and-biomaterial-from-algal-biomass-and-sides/>



In order to facilitate the attendance, no registration fees were requested from attendees, and first priority was given to applicants involved in BlueBio co-funded research projects. Accommodation and local travel expenses were also covered by the BlueBio ERA-NET Cofund, and a travel grant up to 350 euros was offered to all students.

The outline of the course is given below.

**Title: “Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams”**

<i>Aim</i>	Improve knowledge on advanced technologies and biorefinery processes used for valorisation of fishery side streams and by-products, theoretical and practical approaches.
<i>Target</i>	PhD and/or experienced people in the field (priority to applicants from BlueBio COFUND projects)
<i>Indicative period and time frame</i>	Three days (Tuesday-Thursday), October 2023 (24 <sup>th</sup> -26 <sup>th</sup> )
<i>Location, including the virtual option</i>	<p><u>Preferred option</u></p> <p><b>Venue:</b></p> <ul style="list-style-type: none"> <li>- Norwegian University of Science and Technology (NTNU), Department of Biological Sciences Ålesund (IBA), N-6025 Ålesund, Larsgårdsvegen 2 - 4th fl. A-blokka</li> </ul> <p>Webpage: <a href="#">Department of Biological Sciences Ålesund - NTNU</a></p> <p>Features:</p> <ul style="list-style-type: none"> <li>- Easy to reach by plane and bus (local);</li> <li>- Well connected (international airport is located in Vigra, in 30-40 min drive from the Campus);</li> <li>- Availability of facilities (biotechnology and bioengineering laboratories, rooms for lessons, pc, monitors, microphones, etc...)</li> </ul>
<i>Max n. of pax</i>	25
<i>Format</i>	<p>Proposed activities:</p> <ul style="list-style-type: none"> <li>- Front lessons</li> <li>- 1 field visit (1 visit to salmon farms)</li> <li>- 2 practical lessons</li> <li>- Interaction with Entrepreneurs: Blue Legasea, Pretio, etc.</li> </ul>



*Indicative contents*

Based on:

- Innovative pre-treatment technologies
- Biorefinery of fishery side streams and by-products
- Analysis of selected compounds extracted from fishery side streams
- Field visits

*Proposed collaborations*

- Blue Legasea (Norway)
- Consesjon (Norway)

*Selection criteria*

BlueBio- selection based on:

- PhD and/or experienced people in the field (priority to applicants from BlueBio COFUND projects);
- Professional and Academic Background (Chemistry, Biotechnology, Marine Biology, Fishery);
- Nationality;
- Gender.

*Impact indicators*

- N. of submissions and final participants;
- Evaluation survey.

*Budget breakdown*

Tentative budget 35,000 € (Maximum BlueBio contribution), covering:

- Catering & e-coffee meetings
- Venue and digital facilities [free of charge]
- Travel & subsistence for teachers
- Travel & subsistence for students (up to € 350)
- Transfers to laboratories and facilities at sea





### 2.3. Management: organizing and evaluation committees and communication staff

Activities were co-organised by three focus groups joined by representatives of the BlueBio Eranet COFUND and Norwegian University of Science and Technology (hosting Institution) and composed as follows:

#### Technical-Organizing Committee

- *Majbritt Bolton-Warberg (BlueBio ERA-NET Cofund, Marine Institute, Ireland)*
- *Renata Denaro (BlueBio ERA-NET Cofund, CNR-IRSA, Italy)*
- *Gianna Fabi (BlueBio ERA-NET Cofund, CNR- IRBIM, Italy)*
- *Dennis Lisbjerg (BlueBio ERA-NET Cofund, DTU Aqua, Denmark)*
- *Bernardo Patti (BlueBio ERA-NET Cofund, CNR- IAS, Italy)*
- *Janna Crobotova (NTNU, Norway)*
- *Medya Temelli Fenerci (NTNU, Norway)*

#### Selection & Evaluation Committee

- *Majbritt Bolton-Warberg (BlueBio ERA-NET Cofund, Marine Institute, Ireland)*
- *Renata Denaro (BlueBio ERA-NET Cofund, CNR-IRSA, Italy)*
- *Janna Crobotova (NTNU, Norway)*

#### Communication Staff:

- *Sigurður Björnsson (BlueBio ERA-NET COFUND, RANNIS, Iceland)*
- *Hildur Ýr Práinsdóttir (BlueBio ERA-NET COFUND, MATIS, Iceland)*

### 2.4. The process: submission, evaluation and selection

Following the dissemination of the call for applications, published on the BlueBio website on 31<sup>st</sup> May 2023 (<https://bluebioeconomy.eu/announcement-2/>), the deadline for the submission was initially 30<sup>th</sup> June 2023 but subsequently postponed to 31<sup>st</sup> August 2023. The selection process was carried out over the period 4<sup>th</sup> – 14<sup>th</sup> September 2023.

A screenshot of the online announcement is shown below.



### 3-days Advanced Training course in Bio-Refinery technologies on fishery side streams



#### Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams

24-26 October 2023 – NTNU – Department of Biological Sciences Ålesund, Norway

The course on “**Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams**”, an advanced training initiative funded by ERA-NET Cofund on Blue Bioeconomy *Unlocking the Potential of Aquatic Bioresources* (BlueBio) and organised by the Norwegian University of Science and Technology with the support of National Research Council (CNR Italy), is now open for applications.

BlueBio ERANET COFUND is a coordinated R&D funding scheme which aims to strengthen Europe’s competitiveness in the blue bioeconomy and addresses gaps to identify ways of bringing bio-based products and services to the market and find new solutions for creating value in the blue bioeconomy.

The goal of the course is to contribute in improving knowledge and create new skills on advanced technologies and biorefinery processes used for valorisation of fishery side streams and by-products, adopting both theoretical and practical approaches.

The course is open to PhD holders and/or experienced people in the field (priority will be given to applicants from BlueBio ERANET COFUND projects)

**Official language:** English

**Date and Location:**

24 – 26 October 2023, Norwegian University of Science and Technology, Department of Biological Sciences Ålesund (IBA), Ålesund (Norway)

**Contacts:**

BlueBio COFUND (CNR Italy): [gianna.fabi@cnr.it](mailto:gianna.fabi@cnr.it); [bernardo.patti@cnr.it](mailto:bernardo.patti@cnr.it)

Local (NTNU Ålesund): [janna.cropotova@ntnu.no](mailto:janna.cropotova@ntnu.no); [medya.t.fenerci@ntnu.no](mailto:medya.t.fenerci@ntnu.no)

The activity is supported by the BlueBio ERANET COFUND project co-funded by the European Commission within the Horizon 2020 program under GA N. 817992

Candidates were evaluated based on the CVs they submitted using the online application form. The target audience were PhD holders and/or experienced people in the field (both from Research and Industry), with 75% (n=20) of places reserved for people involved in BlueBio co-funded projects. The remaining 25% (n=5), were selected based on the scores from the evaluation process, with the 5 highest scoring applicants not involved with BlueBio projects receiving the first offers.

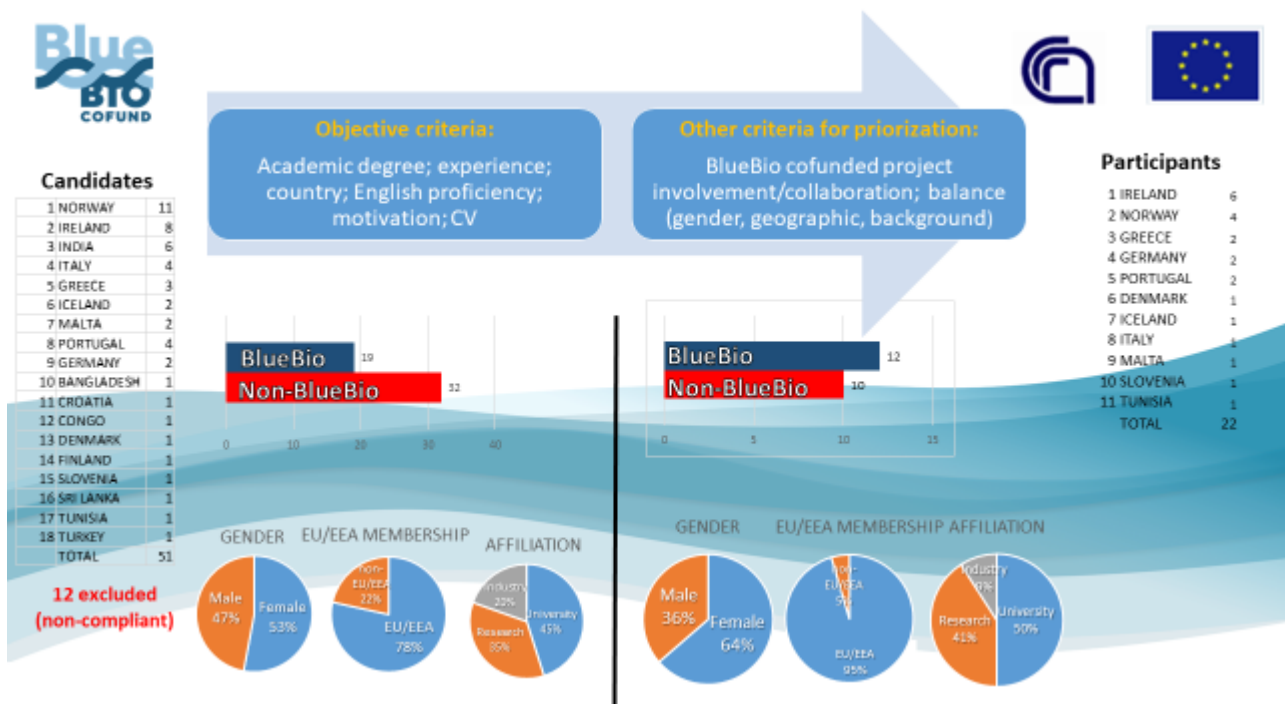


This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement 817992.



Twenty-five people were selected from 50 applicants across 18 different countries. However, due to some late withdrawals that were not possible to replace because they were communicated to the organizing committee very close to the beginning of the event, the total number of attendees that joined the training course was twenty-two.

The composition of candidates and selected students by gender, nationality, affiliation and involvement in BlueBio funded projects is given below.



## 2.5. The Programme

The programme of the training course is reported in Annex 3. It included three sessions, one for each of the days of the course. The first session, entitled “Advanced technologies and innovative solutions for efficient valorisation of fishery side streams”, was dedicated to frontal lessons, the second one focused on practical activities regarding biorefinery of fishery raw materials and interaction with industry, and the third day was devoted to a site visit and teamwork activities. Trainers from both EU and non-EU countries were involved (Annex 4).

A practical laboratory activity actively involving the participants was implemented at facilities made available by NTNU. For this activity, the students were divided into 2 groups, each of which had to conduct a biorefinery process based on enzymatic extraction of fish oil and peptides from Atlantic mackerel side streams by enzymatic hydrolysis in a stationary bioreactor at NTNU I Ålesund. The extraction steps are shown in the figure below.



### Biorefinery lab activity: extraction of fish oil and hydrolysates from Atlantic mackerel



1<sup>st</sup> step:  
Ultrasound treatment



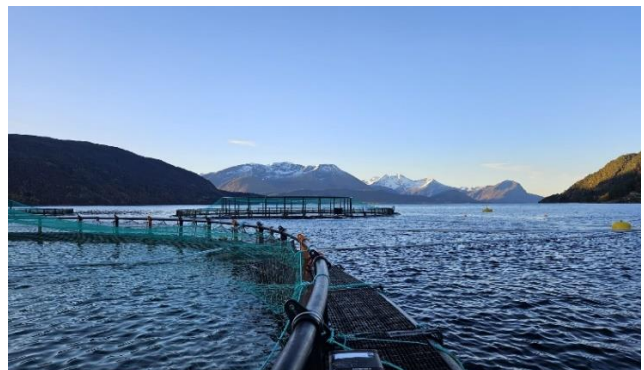
2<sup>nd</sup> step:  
Enzymatic hydrolysis



3<sup>rd</sup> step:  
Separation of lipid and protein fractions



In the morning of the third day of the course a site visit was organised to the SalMar Organic ASA salmon farming facility located in Gudmundset (about 25 km far from NTNU in Ålesund; see below).

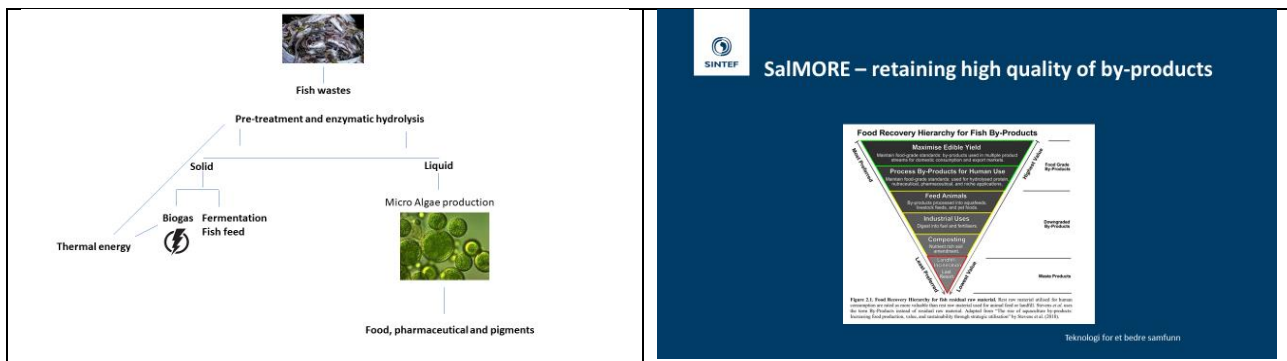


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In the afternoon of the same day the attendees were divided into four groups and invited to a teamwork practise session dealing on bio-refinery process planning and on HCB implementation.

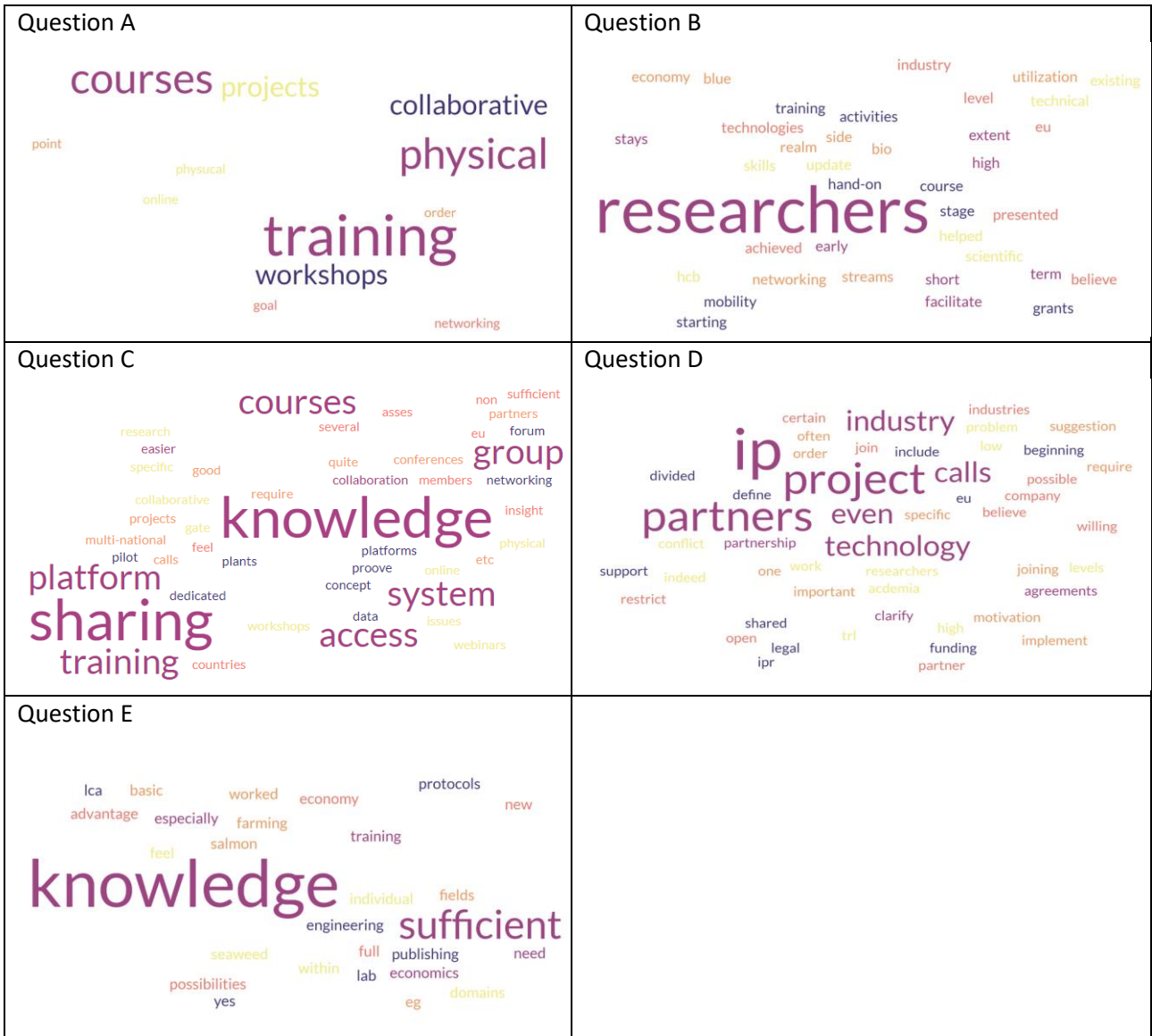
The first exercise consisted of drafting a research project on seafood biomass biorefinery in the context of the Blue Bioeconomy in around one hour, based on what it has been learned during the first two days. Each group was then asked to present its own project in 5 minutes. The exercise was highly successful and showed an active cooperation among the members of each group. A couple of slides extracted from the presentations by the four workgroups are reported in the picture below.



The second exercise was meant to get the opinion of participants on the actions needed to implement HCB in the field of biorefinery and in the EU context. To this aim, the four groups were asked to reply to the following questions:

- A) Which are, in your opinion, the most effective practices to implement HCB in research on biorefinery of products from fishery, aquaculture and seafood processing (e.g., physical training courses, online training courses, webinars/workshops on specific issues, collaborative projects, etc.)?
- B) In your opinion, to which extent has the HCB activity on biorefinery applied to fishery, aquaculture and seafood processing implemented up to date at EU level, met the needs of research and industry?
- C) Are our systems for knowledge sharing currently used in EU effective enough? – how can we improve interactions e.g., between North and South? Which mechanisms/tools could be developed for this?
- D) Research/Innovation projects on biorefinery often aim to develop products with a certain TRL. This involves property rights which could hamper mobility of staff and exchange of information among projects (and/or among project partners), working in the same industry. Do you have any suggestions to overcome this obstacle?
- E) Do you find that your basic knowledge is sufficient in order to take advantage of the new knowledge and possibilities in advancing the blue bioeconomy? Or do you e.g., need further knowledge of other basic disciplines than your initial training (e.g., in economics, chemistry, physics, genomics)?

The results of the questionnaire are reported below.



In general, physical training courses and workshops have been highlighted as the most effective practices to be adopted as a tool for favouring networking and the development of collaborative projects. HCB activity on biorefinery applied to fishery sidestreams were considered highly relevant to meet the needs of research and the industry, as it is able to facilitate short term stays and mobility grants, to update researchers on the state of the art and to help them establishing networking with industry.

Knowledge sharing can be improved by establishing group platforms for data sharing and collaboration, by granting access to pilot plants for proof of concept developments, by providing webinar/workshops on specific issues, by organising international conferences and calls for proposals, although there is not sufficient insight on the effectiveness of the current EU knowledge sharing system.



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Issues involving property rights, often hampering mobility and exchange of information among projects, could be overcome by funding the necessary legal support to the development of partner agreements clarifying the sharing of IPs, by launching call proposals separated by TRL levels (high/low), and by involving industry the research partnerships having no limitation in the sharing of IPs.

Finally, the participants recognised that there is not enough basic knowledge, however their perception was that improved collaboration and exchange with experts in different fields would fill this gap more effectively than training courses on basic disciplines. Specifically, more training is needed especially on economics, LCA and engineering.

## **2.6. Feedback and lessons learned**

A further individual questionnaire was circulated among the participants to get their feedback on the course. The analysis of replies (21 out of 22 participants) showed that their expectations were in general satisfactorily addressed (on a scale of 1 to 5, average score was greater than 4 for each one of the 11 evaluation questions). Most of presentations by the invited lecturers were highly appreciated, as well as the possibility of interacting with them and the quality of the laboratory facilities used for the practical experience.

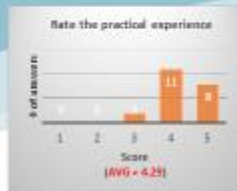
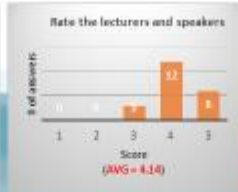
Suggestions from the audience future training initiatives on Blue Bioeconomy mostly regarded the possibility of giving more room to discussion and teamworking, extending lectures to circular industrial issues, bio-economy, safety and quality aspects, supply chain management and LCA seaweed and crustacean shell waste biomass recycling and about the different field of fish waste applications.

Other specific suggestions were about the availability of printed presentations and lab protocols prior to the lectures (in order to take notes directly on the slides or during the practical work), the distribution of name badges and contact detail lists (to remember names and for connections).

The main results of the survey are summarized in the two slides hereafter.



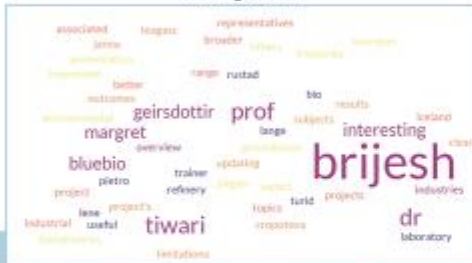
**VALUE BACK SURVEY**  
(5 = highest rating, 1 = lowest rating)



**VALUE BACK SURVEY**



Which speakers or topics you would like to see again at a future training course?



Feel free to further comment/provide suggestions to improve a future edition of a training course on blue biotechnologies



Please specify which topics you would like to be analysed more in depth in a future training course.?



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## ANNEX 1. Agenda of the Human Capacity Building e-coffee meeting.

# BlueBio Cofund

## Human Capacity Building e-coffee meeting | agenda



Date and time: 06 April 2022, 14:00-16:00 CET

Meeting venue: Video conference

Join Zoom Meeting: <https://zoom.us/j/94882700844?pwd=WVdRMEdTc3ZmN2NRTWZNVDBOM1RIQT09>

Meeting ID: 948 8270 0844, Passcode: 207291

**Objectives:** *The first objective of the meeting is to promote HCB in BluBio co-funded projects. Some examples of HCB initiatives within projects will be presented, and this will pave the way for discussing about the HCB efforts already done (or planned) by the projects and their challenges, and for facilitating the exchange of best practices.*

*In the second part of the meeting we will also have the opportunity of considering different forms of assistance that BlueBio Cofund could deliver about HCB to the funded projects (e.g. support in the organisation of training courses, workshops, webinars, etc.), taking into account their needs and starting from the opinions expressed in the questionnaires by the project coordinators. Issues about communication and sharing of HCB among BlueBio projects will be also addressed.*

### Agenda – all hours are CET

- 14:00-14:10 **Welcome and Introduction**  
"Why HCB is important in BlueBio?" (Bernardo Patti)
- 14:10-14:40 **Examples of HCB implementation from two funded projects**
- Digiras (Dr. Roman Netzer)
  - MedSpon (Prof. Carlo Cerrano)
- 14:40-15:10 **Roundtable discussion/ discussion in small groups** (20 minutes group discussion + 10 minute summary all together):
- What HCB have you been doing?
  - How has it been going?
  - What can you do now, to reach your commitments?
- 15:10-15:20 **Supporting Human Capacity Building in BlueBio projects: insights from the questionnaires** (Bernardo Patti)
- 15:20-15:50 **Roundtable discussion/ discussion in small groups** (20 discussion + 10 minute synthesis):
- How can the BlueBio Cofund assist? Which format? How might external organisations (universities, other ERA-Nets, industry) contribute?
  - Which themes?
  - Communication and sharing of HCB among BlueBio projects.
- 15:50-16:00 **Wrap-up and final comments**



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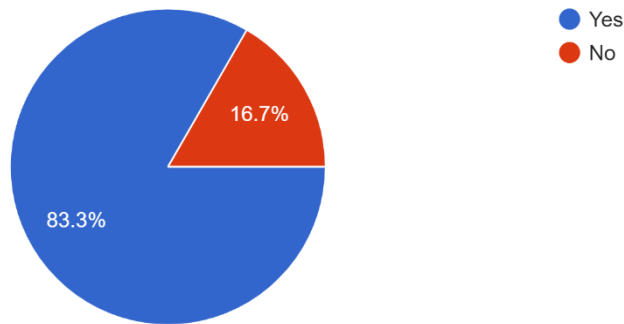
## ANNEX 2 - Human Capacity Building (HCB) activities in support of BlueBio funded projects – Tools and topics – Summary of responses

The following questionnaire is kindly asked to be filled out by the coordinators of projects co-funded under the first 2018 Call.

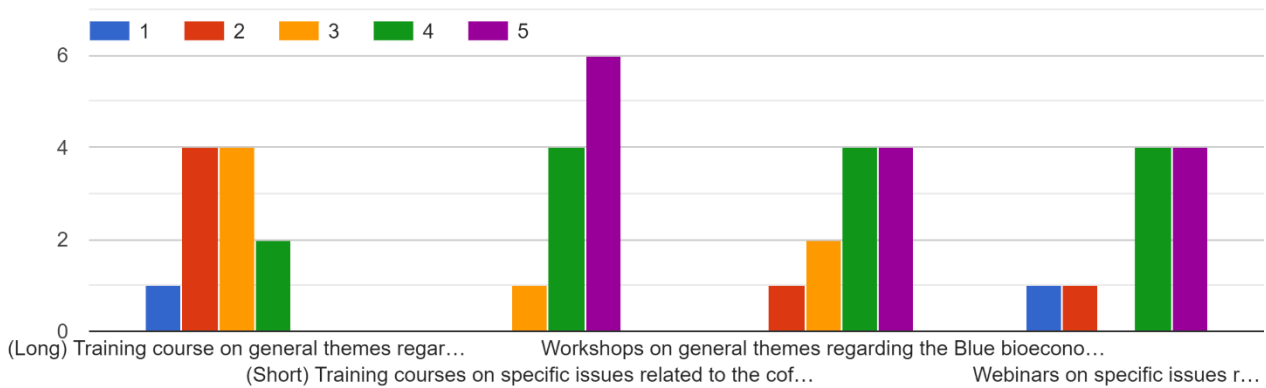
Deadline for submission of questionnaire: 18.03.2022

Would you like BlueBio cofund be in charge for the organisation of HCB events related to the needs of your project?

12 responses



If yes, which kind of HCB initiatives would you consider more effective? Make your choice for each proposed item, giving a score from 1 (less effective) to 5 (more effective).



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 817992.



### ANNEX 3. Programme of the third BlueBio Advanced Training course

Advanced BlueBio Training course: “Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams”, 24<sup>th</sup>-26<sup>th</sup> October 2023, Norwegian University of Science and Technology (NTNU), Department of Biological Sciences (IBA), Ålesund (Norway).

Monday 23 <sup>rd</sup> October	Tuesday 24 <sup>th</sup> October	Wednesday 25 <sup>th</sup> October	Thursday 26 <sup>th</sup> October
	Moderator: Janna Cropotova (NTNU, Norway)	Moderator: Janna Cropotova (NTNU, Norway)	Moderator: Janna Cropotova (NTNU, Norway)
Arrival	<p>9:00</p> <p>Welcome &amp; Programme presentation <i>Assoc. Prof. Janna Cropotova</i></p> <p>9:10</p> <p>Institutional greetings from Vice-Rector of NTNU i Ålesund <i>Anne-Lise Sagen Major</i></p> <p>and</p> <p>Head of Department of Biological Sciences Ålesund <i>Tove Havnegjerde</i></p> <p>9:30</p> <p>BlueBio ERANET Cofund Project coordinator, RCN, Norway <i>Ingeborg Korme</i></p> <p>and</p> <p>Task 7.3 Leader, CNR, Italy <i>Bernardo Patti</i></p>		



Advanced BlueBio Training course: “Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams”, 24 <sup>th</sup> -26 <sup>th</sup> October 2023, Norwegian University of Science and Technology (NTNU), Department of Biological Sciences (IBA), Ålesund (Norway).			
Monday 23 <sup>rd</sup> October	Tuesday 24 <sup>th</sup> October	Wednesday 25 <sup>th</sup> October	Thursday 26 <sup>th</sup> October
	Moderator: Janna Cropotova (NTNU, Norway)	Moderator: Janna Cropotova (NTNU, Norway)	Moderator: Janna Cropotova (NTNU, Norway)
	Session 1 Advanced technologies and innovative solutions for efficient valorisation of fishery side streams	Session 2 Practical activities and interaction with industry	Session 3 Site visit and teamwork
	10:00 Importance of fish oil: case study of seasonal variation of gurnard oil from discards  <i>Dr. Narcisa Bandarra Head of Aquaculture and Upgrading Division Portuguese Institute of Sea and Atmosphere (IPMA), Lisbon, Portugal</i>	8:00 – 12:00 Laboratory activity on extraction of protein and lipid compounds by enzymatic hydrolysis  (under supervision of Egidijus Dauksas/Elissavet Kotsoni and Kristine Kvangarsnes)	9:00 – 12:00 Visit to fish farms in the region
		13:00 Lunch	12:00 Lunch
	10:30 Heterotrophic growth of <i>Galdieria sulphuraria</i> on residues from aquaculture and fish processing industries  <i>Dr. Stephanie Schönfelder Institut für Lebensmittel- und Umweltforschung e.V. (ILU) Papendorfer Weg 3 14806 Bad Belzig</i>	14:00 Lectures from representatives from the seafood processing industries (3 presentations)	13:00 – 16:00 Teamwork practise sessions  - Biorefinery process planning (drafting a research project on biomass biorefinery in the context of the Blue Bioeconomy). Actions needed to implement HCB in the field of biorefinery (team questionnaire)  - Feedback and lessons learned (individual questionnaire)



Advanced BlueBio Training course: “Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams”, 24 <sup>th</sup> -26 <sup>th</sup> October 2023, Norwegian University of Science and Technology (NTNU), Department of Biological Sciences (IBA), Ålesund (Norway).			
Monday 23 <sup>rd</sup> October	Tuesday 24 <sup>th</sup> October	Wednesday 25 <sup>th</sup> October	Thursday 26 <sup>th</sup> October
	Moderator: Janna Crobotova (NTNU, Norway)	Moderator: Janna Crobotova (NTNU, Norway)	Moderator: Janna Crobotova (NTNU, Norway)
	11:00 Superchilling of fish – effect on shelf life and quality <i>Prof. Turid Rustad</i> <i>Department of</i> <i>Biotechnology and Food</i> <i>Science, Norwegian University</i> <i>of Science and Technology,</i> <i>Trondheim, Norway</i>		
	11:30 Coffee break	15:30 Coffee break	
	12:00 Achieving zero waste seafood chains via Novel Biorefineries <i>Prof. Brijesh K Tiwari</i> <i>Principal Research Officer,</i> <i>Teagasc Food Research Centre</i> <i>Dublin, Ireland</i>	16:00 – 17:00 Discussion with representatives from industries	16:00 End of the course Departure of participants



Advanced BlueBio Training course: “Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams”, 24<sup>th</sup>-26<sup>th</sup> October 2023, Norwegian University of Science and Technology (NTNU), Department of Biological Sciences (IBA), Ålesund (Norway).

Monday 23 <sup>rd</sup> October	Tuesday 24 <sup>th</sup> October	Wednesday 25 <sup>th</sup> October	Thursday 26 <sup>th</sup> October
	Moderator: Janna Cropotova (NTNU, Norway)	Moderator: Janna Cropotova (NTNU, Norway)	Moderator: Janna Cropotova (NTNU, Norway)
	<p>12:30</p> <p>Innovative technological solutions for advanced extraction of valuable compounds from pelagic fish side streams and improving their functional properties</p> <p><i>Assoc. Prof. Janna Cropotova</i> <i>Department of Biological Sciences</i> <i>Ålesund</i> <i>Norwegian University of Science and Technology, Ålesund, Norway</i></p>		
	<p>13:00 Lunch</p>		
	<p>14:00</p> <p>Emerging processing strategies for quality improvement and side streams valorization of crustaceans</p> <p><i>Assoc. Prof. Pietro Rocculi</i> <i>Alma Mater Studiorum University, Bologna, Italy</i></p>		
	<p>14:30</p> <p>Extraction of marine lipids from fish side streams: possibilities and challenges</p> <p><i>Dr. Revilija Mozuraityte</i> <i>SINTEF Ocean, Trondheim, Norway</i></p>		



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 817992.



Advanced BlueBio Training course: “Resilient Blue Bio-refinery technologies: innovative solutions to valorise fishery side streams”, 24<sup>th</sup>-26<sup>th</sup> October 2023, Norwegian University of Science and Technology (NTNU), Department of Biological Sciences (IBA), Ålesund (Norway).

Monday 23 <sup>rd</sup> October	Tuesday 24 <sup>th</sup> October	Wednesday 25 <sup>th</sup> October	Thursday 26 <sup>th</sup> October
	Moderator: Janna Crobotova (NTNU, Norway)	Moderator: Janna Crobotova (NTNU, Norway)	Moderator: Janna Crobotova (NTNU, Norway)
From 18:00 Welcome, technical details, organisation, programme, get together, query about expectations	15:00 Full utilisation of sidestreams from the Icelandic fish and aquaculture sectors - Status <i>Dr. Margret Geirsdottir Matis, Reykjavik, Iceland</i>		
	15:30 Coffee break		
18:30 Ice breaking presentation 2' per student	16:00 – 17:30 Discussion with teachers		
19:30 Dinner	19:30 Dinner	19:30 Dinner	





## ANNEX 4. Information on Instructors & Lessons

### Narcisa Bandarra



**Affiliation:** IPMA, Institute of Sea and Atmosphere : <http://www.ipma.pt>

**Contact:** [narcisa@ipma.pt](mailto:narcisa@ipma.pt)

**Biography:** Narcisa Bandarra holds habilitation in Ocean Sciences by Faculty of Sciences of Lisbon and PhD in Biotechnology by Instituto Superior Técnico of Lisbon. She is Head of Aquaculture, Upgrading and Bioprospecting Division from Portuguese Institute for the Sea and Atmosphere, I.P. (IPMA) from 2014, she has thirty years of scientific work in the area of upgrading of fishery and aquaculture products with special focus on biochemical and nutritional value of fishery and aquaculture products, seeking their importance for health and wellbeing of consumers as well as upgrading the best of these products by the productive sector.

The result of her scientific activity is reflected in the publication more than one hundred ninety-five scientific articles in international journals, participation in fifty-five projects of national and international R&D and the orientation of seventy-seven undergraduate, master, doctorate and national international postdoctoral students. She is the Portuguese focal point of European Fish Technologists Association (WEFTA) and she was invited as expert to the High Level Panel in Ocean Economy (HLPO) <https://oceanpanel.org/>. In October 2023, she received the WEFTA Award 2023 at the 51st Annual WEFTA Meeting in Copenhagen, Denmark. The award is given to members of WEFTA having made an outstanding contribution to the profession of seafood science and technology in Europe.

**Researcher ID:** C-4780-2013

**URL:** <http://www.researcherid.com/rid/C-4780-2013>

**ORCID:** <http://orcid.org/0000-0002-7563-9226>

**Title of the lesson:** Importance of fish oil: case study of seasonal variation of gunard oil from discards

**Date of the lesson:** 24th of October 2023

**Presentation/Focus of the lesson:**

Gurnard is an abundant fish in the Northeast Atlantic but is mostly caught as due the activity of trawl fishery as a by-catch and discarded most of the time. However, this fish has a very interesting nutritional composition, especially regarding its lipid composition. Thus, the objective of this work was to characterize the gurnard oil recovered from the production of protein hydrolysates, from heads (GH) and bones and skins (GSB), of gurnard caught off in different seasons. The samples of gunard oil were analyzed by GC-FID to evaluate the fatty acid profile. The saturated fatty acids (SFA) were around 29% of the total fatty acids for both GH and GSB and constant during the year. Concerning the monounsaturated fatty acids (MUFA) a slight decrease was registered from summer (43-44%) to winter (39-40%) in both matrices. The polyunsaturated fatty acids (PUFA) were between 25% to 31% and increased proportionally from summer to winter. The high level of PUFA present in the oil were mainly from  $\omega$ 3 family corresponding to 24.5% in GH and 25.7% in GSB. Among these  $\omega$ 3 PUFA a high percentage of EPA (20:5  $\omega$ 3) and DHA (22:6  $\omega$ 3) was recorded. The DHA content was always higher than 10% of the total fatty acids and increased from summer to spring reaching a maximum of 13% in both oils. Meanwhile, it was in autumn that GH and GSB oils attained the highest level of EPA (around 9%). As a conclusion, no relevant differences were observed between both oils. Regarding the seasonal variation, it seems that the period between autumn and spring was the most adequate to obtain gurnard oil richer in  $\omega$ 3 PUFA, particularly EPA and DHA. This data emphasizes the importance of the zero waste in blue circular economy.



## Janna Crobotova



**Affiliation:** Norwegian University of Science and Technology (NTNU)

**Contact:** [janna.crobotova@ntnu.no](mailto:janna.crobotova@ntnu.no)

**Biography:** Janna Crobotova is currently working as Associate Professor at the Department of Biological Sciences in Ålesund (NTNU). She was awarded a PhD degree in 2016 in the field of Food Technology and has gained a 10-year R&D experience in the field of Food Science, Innovation and Technology. Her areas of scientific interest include *preservation of nutritional quality and health benefits in food (particularly seafood) products during processing and storage, development of novel methods for rapid and non-invasive assessment of food deterioration, extraction of valuable ingredients from fish side streams, and shelf-life prediction.*

Between 2017-2019, Janna Crobotova worked as postdoctoral fellow at the Department of Biotechnology and Food Science (NTNU) on the topics dedicated to advanced fish processing and preservation methods to improve nutritional and sensory quality of pelagic fish products, while extending their shelf life.

Janna Crobotova is the first author and co-author of more than 40 articles and 7 patents devoted to the new food technologies, which were industrially tested and implemented at a number of manufacturing companies. Her patents were awarded several gold and silver medals at international R&D exhibitions, and she was working as an external consultant at some food companies, EFSA and project evaluator for EU-projects. In addition, she is a project coordinator of BlueBio ERA-NET project "IMPRESSIVE - Improved Processing to Enhance Seafood Sidestream Valorisation and Exploration" (2022-2026), project number 341732: <https://bluebioeconomy.eu/improved-processing-to-enhance-seafood-sidestream-valorization-and-exploration/> and PI of ERA-NET project "CLIMAQUA –Establishing an innovative and transnational feed production approach for reduced climate impact of the aquaculture sector and food supply"(2021-2024): [Establishing an innovative and transnational feed production approach for reduced climate impact of the aquaculture sector and food supply - Prosjektbanken \(forskingsradet.no\).](https://prosjektbanken.forskingsradet.no/)

**Title of lesson:** Innovative technological solutions for advanced extraction of valuable compounds from pelagic fish side streams and improving their functional properties

**Date of lesson:** 24<sup>th</sup> of October 2023

**Presentation/Focus of the lesson:**

The utilization of fish side streams as a source of bioactive peptides and functional protein ingredients has recently become increasingly popular for various industrial applications. Fish side streams and by-products contain high-quality protein comprising all essential amino acids, making it a complete protein source. Therefore, there is a big interest towards effective techniques or methods of extraction and modification of the spatial structure of peptide molecules to improve the quality of the extracted compounds. Utilizing fish side streams can improve the resource efficiency, environmental sustainability, and economic viability of the seafood industry, as well as provide novel applications in health promoting foods, feeds (both animal and fish feed), nutraceuticals, and pharmaceuticals. However, there are several challenges and bottlenecks that prevent more sound exploitation of fish side streams, such as sorting technologies, storage conditions, extraction technology requiring innovations, and regulatory frameworks.

The BlueBio IMPRESSIVE project is an initiative that aims to solve these challenges by developing advanced technological solutions to convert fish side streams into high-value ingredients such as bioactive peptides, protein-based food ingredients, and fish oil.

In the talk of Janna Crobotova, the effects of high- and low-power and low-frequency (20 kHz) ultrasound post- and pretreatments on the physicochemical, structural, and functional characteristics of fish protein hydrolysates (FPH) recovered by enzymatic hydrolysis from pelagic fish side streams (herring and mackerel), as a part of IMPRESSIVE project activities, were presented.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 817992.



## Margrét Geirsdóttir



**Affiliation:** Matis ohf, Reykjavík Iceland. <https://matis.is/>

**Contact:** [mg@matis.is](mailto:mg@matis.is)

**Biography:** Margrét Geirsdóttir is a Project Manager at Matís, Food and Biotech, at the Bioactive compounds research group.

Matís is a government owned, non-profit, independent research company, founded in 2007 following the merger of three former public research institutes. Matís does pursue research and development aligned to the food and biotechnology industries as well as providing Iceland's leading analytical testing service for public and private authorities. Value creation within the bioeconomy and the development of policy and infrastructure in areas in need of understanding and training in the food production is one of our expertise. Matís' vision is to increase the value of food processing and food production, through research, development, dissemination of knowledge and consultancy, as well as to ensure the safety and quality of food and feed products.

Margrét holds B.Sc. degrees in Chemistry and Food Science from University of Iceland and a M.Sc. in Food Scienc from the Royal Veterinary and Agricultural University in Denmark (KVL now a part of the University of Copenhagen). Margrét started to work at the Icelandic Fisheries Laboratories (IFL) in 1998 now part of Matís since 2007. Main research has been utilisation of proteins from fish raw materials, including protein isolation and enzymatic hydrolysis to develop products like surimi, fish protein hydrolysates with bioactive properties and collagen from fish skin.

**Title of the lesson:** Full utilisation of sidestreams from the Icelandic fish and aquaculture sectors - Status

**Date of the lesson:** 24<sup>th</sup> of October 2023

**Presentation/Focus of the lesson:**

For the past 25 years, a major change has been in the Icelandic fish industry when it comes to full utilisation of raw materials. Matis, the Icelandic universities and research institutions have been in leading position in collaboration with the fish industry as well as the Icelandic government to make this change possible. In the lesson, Margrét gave an overview over this change, current situation and what was the driving force to make this change possible. Furthermore, what challenges we need to overcome to bring the industry further to our final goal, 100% utilisation of the valuable and nutritious raw materials that can be found below water.



## Revilija Mozuraityte



**Affiliation:** SINTEF Ocean

**Contact:** [Revilija.mozuraityte@sintef.no](mailto:Revilija.mozuraityte@sintef.no)

**Biography:** Revilija Mozuraityte is a senior research scientist at SINTEF Ocean, Department of Fisheries and New Biomarine Industry, Ingredient Technology group. SINTEF is an independent, non-profit research organisation in Norway working across all fields of technology. The research group Ingredient Technology focuses on 100 % utilization of harvested and cultivated marine and non-marine resources for production of ingredients for food, feed and other uses.

Revilija Mozuraityte has a M.Sc from Kaunas University of Science and Technology (KTU), Lithuania, and Ph.D. from the Norwegian University of Science and Technology (NTNU), Norway. Ph.D thesis focused on Oxidation of Marine Phospholipids in Liposomes. Her research interests at SINTEF Ocean have expanded to processing, modification, stabilisation of marine lipids through the whole processing chain, starting from the storage of the raw material, processing into ingredients, modification and final production, and stabilization. Revilija Mozuraityte is participating and leading several national and international projects, e.g. ERA-BlueBio projects: BlueGreenFeed and Impressive.

**Title of lesson:** Extraction of marine lipids from fish side-streams: possibilities and challenges

**Date of lesson:** 24<sup>th</sup> of October 2023

**Presentation/focus of the lesson:**

There is an increased demand in omega-3 oils and to fulfil the increasing demand we need to optimize the use of available raw material or to find new, novel resources for omega-3 oils. When filleting fish, fillet usually is the main products, while the rests like skins, backbones are usually human consumption grade quality and can be processed into ingredients for human consumption. However, marine rest raw materials are very perishable, and therefore to produce good quality ingredients, the quality should be maintained through the whole processing chain from raw material handling to the final product storage. During presentation was discussed possibilities and challenges for stabilisation of raw material during handling and processing. For raw material handling is challenging to control enzymatic degradation of omega-3 lipids, additional of antioxidants helps to reduce oxidation. Different processing technologies can be used to extract lipids, and additional of right antioxidant helps to reduce oil oxidation during production. SINTEF developed model system that can help to select effective antioxidants.



## Pietro Rocculi



**Affiliation:** *Alma Mater Studiorum* – University of Bologna

**Contact:** [pietro.rocculi3@unibo.it](mailto:pietro.rocculi3@unibo.it)

**Biography:** Pietro Rocculi is Associate Professor at the Department of Agricultural and Food Sciences, University of Bologna (Italy). He obtained his Ph.D. in Food Science and Technology at the University of Bologna, in 2005. His principal research topics are focused on physical properties and water mobility in food, innovative non-thermal treatments for food processing, stabilization and by-products valorisation, and on the use of modified atmosphere for food processing and packaging. He participated/coordinated many national and international research projects. He is co-author of more than 220 scientific

publications, 138 in peer reviewed journals (Scopus h-index 32, total citations 4942, Scopus Access 31th October, 2023). He has attended to many national and international symposia. From 2018, he is Deputy Director of the Interdepartmental Centre for Agrofood Industrial Research of University of Bologna.

**Title of the lesson:** Emerging processing strategies for quality improvement and side streams valorisation of crustaceans

**Date of the lesson:** 24<sup>th</sup> of October 2023

**Presentation/Focus of the lesson:**

The crustacean processing industry has experienced significant growth over recent decades resulting in the production of a great number of by-products. Crustacean by-products contain several valuable components such as proteins, lipids, and carotenoids, especially astaxanthin and chitin. When isolated, these valuable compounds are characterized by bioactivities such as anti-microbial, antioxidant, and anti-cancer ones, and that could be used as nutraceutical ingredients or additives in the food, pharmaceutical, and cosmetic industries. Different innovative non-thermal technologies have appeared as promising, safe, and efficient tools to recover these valuable compounds.

This presentation aimed at providing a summary of the main compounds that can be extracted from crustacean by-products, and of the results obtained by applying the main innovative non-thermal processes for recovering such high-value products. Moreover, from the perspective of the circular economy approach, specific case studies on some current applications of the recovered compounds in the seafood research/industry with different TRL were presented.

The extraction of valuable components from crustacean by-products, combined with the development of novel technological strategies aimed at their recovery and purification, will allow for important results related to the long-term sustainability of the seafood industry to be obtained. Furthermore, the reuse of extracted components in seafood products is an interesting strategy to increase the value of the seafood sector overall. However, to date, there are limited industrial applications for this promising approach.

**Links to the websites of the organisation represented for the lesson:**

<https://distal.unibo.it/en/index.html>

**Suggested background material:**

Pulsed Electric Fields (PEF) and Accelerated Solvent Extraction (ASE) for Valorization of Red (*Aristeus antennatus*) and Camarote (*Melicertus kerathurus*) Shrimp Side Streams: Antioxidant and HPLC Evaluation of the Carotenoid Astaxanthin Recovery. De Aguiar Saldanha Pinheiro, A.C., Martí-Quijal, F.J., Barba, F.J., ... Tappi, S., Rocculi, P. *Antioxidants*, 2023, 12(2), 406

Innovative non-thermal technologies for recovery and valorization of value-added products from crustacean processing by-products—an opportunity for a circular economy approach. Pinheiro, A.C.D.A.S., Martí-Quijal, F.J., Barba, F.J., Tappi, S., Rocculi, P. *Foods*, 2021, 10(9), 2030

Quality changes during frozen storage of mechanical-separated flesh obtained from an underutilized crustacean. Tappi, S., Pinheiro, A.C.D.A.S., Mercatante, D., ... Capozzi, F., Rocculi, P. *Foods*, 2020, 9(10), 1485



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 817992.



## Turid Rustad



**Affiliation:** NTNU (Dep. Biotechnology and Food Science)

**Contact:** [turid.rustad@ntnu.no](mailto:turid.rustad@ntnu.no)

**Biography:** Turid Rustad is a professor in Food science at Department of Biotechnology and Food Science, NTNU. NTNU, the Norwegian University of Science and Technology is the largest university in Norway. NTNU is Norway's primary centre for technological research and education with a firm foundation in natural sciences. Close co-operation between the different disciplines is one of NTNU's key features. It allows the development of interdisciplinary programmes that unite many areas of specialisation and cross the boundaries of faculties and departments. Department of Biotechnology and Food Science (IBT) has integrated research activities within: Analysis and control of microbial systems, biopolymers and biomaterials, microbial biotechnology and food science. The main research focus of the group of food science is on the biochemistry and quality of food raw

material and the changes taking place during processing.

Turid Rustad holds a MSc and a PhD from NTNU. Her main fields of competence are biochemistry and quality of marine raw materials and how these change during processing. Turid Rustad has extensive experience in characterization of fish using different chemical and biochemical techniques and also a wide experience in innovative seafood processing and preservation methods. She has long experience in research on rest raw materials both from seafood and meat value chains. She has taken part in and also coordinated many national, Nordic and international research projects.

**Title of the lesson:** Superchilling of fish – effect on shelf life and quality

**Date of the lesson:** 24th of October 2023

**Presentation/Focus of the lesson:**

Seafood and especially rest raw materials and sidestreams are highly perishable and there is a need for good and efficient preservation methods that can preserve the valuable nutrients in the raw material. Superchilling is defined as chilling the products to a temperature close to or below the initial freezing point. For fish this is usually between -0.5 to -2.5 °C. Superchilling can inhibit most autolytic and microbial changes in fish compared to normal chilling. Partial freezing of the water in the fish will lead to increased concentrations of solutes in the unfrozen phase. This may again result in increased enzymatic activity and protein denaturation. Superchilling has been shown to lead to a doubling of the shelf-life of salmon with little negative effect on quality parameters like drip loss and texture. For superchilling to be efficient as a preservation method it is important that the raw material is superchilled as fast as possible after harvest/slaughter. Superchilling could have potential as a preservation method for highly perishable seafood sidestreams.

**Suggested background material:**

<https://ifst.onlinelibrary.wiley.com/journal/13652621>

[10.1016/j.foodchem.2007.05.020](https://doi.org/10.1016/j.foodchem.2007.05.020)

[10.1016/j.foodchem.2007.05.051](https://doi.org/10.1016/j.foodchem.2007.05.051)

[10.1016/j.foodchem.2006.10.040](https://doi.org/10.1016/j.foodchem.2006.10.040)



## Stephanie Schönfelder



**Affiliation:** Institute for Food and Environmental Research (ILU e.V.), Bad Belzig, Germany

**Biography:** Stephanie Schönfelder is a scientific coworker at the Institute for Food and Environmental Research (ILU e.V.), located in Bad Belzig, Germany. She graduated in Biochemistry at the University of Potsdam. After years of basic research on microalgae, both at Potsdam University and the Max-Planck-Institute for Molecular Plant Physiology, she moved to applied research and started working at ILU in 2018, mainly on projects involving photoautotrophic or heterotrophic algae cultivation.

The ILU is a non-profit research institution with more than 30 years of expertise in the areas of food processing, environmental research and biotechnology. The primary concern of ILU is applied scientific and technological research with a focus on sustainability, resource efficiency and bioeconomy, including blue bioeconomy. Its research shall deliver results that lead to specific products, activities and processes that protect and improve our environment and food.

<https://www.ilu-ev.de/>

**Title of talk:** Heterotrophic growth of *Galdieria sulphuraria* on residues from aquaculture and fish processing industries

**Date of lesson:** 24<sup>th</sup> of October 2023

**Presentation/Focus of the lesson:**

The talk essentially presents the latest results achieved in the FOSC ERA-NET Project CLIMAQUA. This project develops an innovative process for converting and recirculating aquaculture side-streams (sludge and wastewater) in algae (*Galdieria sulphuraria*)-based feed production for aquacultures. CLIMAQUA involves 4 European and 3 African partners and aims at the development of flexible production systems that can be used in a decentralized manner in the areas of aquaculture and fish processing, thus contributing to regional development and the reduction of greenhouse gases.

Within this framework it could be demonstrated that, the use of complex side-streams from aquaculture in heterotrophic algae-cultivation is possible, even avoiding the challenges arising from non-sterile conditions.



## Brijesh K Tiwari



**Affiliation:** University College Dublin

**Current Positions:**

Principal Research Officer, Teagasc – Irish Agriculture and Food Development Authority. Professor (Adjunct), University College Dublin (2016 – date)

**Research Interests:**

- Sustainable food processing, preservation and production technologies
- Mitigate emerging food production and processing challenges

**Biography:** Professor Tiwari is a Principal Research Officer at Teagasc – Irish Agriculture and Food Development Authority and Professor at UCD School of Biosystems Engineering. Professor Tiwari have an internationally recognised reputation for food engineering research as evidenced by his Highly Cited Researcher designation continuously since 2018 by Clarivates (web of Science). Prof Tiwari have developed, funded and led ab initio my Advanced

Food Processing Technologies Research Group to become a strong multidisciplinary research group with an excellent international track record in delivering high quality research and innovation metrics, including patents and technology transfer. He has published over 250 high impact peer reviewed journal papers, presented over 200 national and international events including over 200 as invited speaker, keynote lectures, co-edited 14 books and currently he is a book series editor for IFST Advances in Food Science book series. His core area of research is in the area of sustainable innovative technologies to mitigate emerging food production and processing challenges. He leads a team of over 25 researchers including postdoctoral researchers/Research officers and PhDs in the area of sustainable food processing and preservation technologies. To date Prof Tiwari, have supervised >50 research theses to completion as Principal Supervisor/Co-supervisor. Supervised >30 postdoctoral/contract researchers. His research group has hosted Visiting Faculty/researchers from EU and non-EU (UK, Brazil, France, Italy, Serbia and USA). His editorial responsibilities include Editor LWT – Food Science and Technology and Editor – Food Chemistry and Editorial board member of Ultrasonics Sonochemistry, Food Engineering Reviews. He is also fellow of Royal Society of Chemistry (FRSC), Fellow Institute of Food Science and Technology (FIFST, UK), Fellow of Association of Food Scientists and Technologists (FAFSTI, India).

**Title of the talk:** Achieving zero waste seafood chains via Novel Biorefineries

**Date:** 24<sup>th</sup> of October 2023