BIOAQUA'S 1ST HIGH-PERFORMANCE WORKSHOP

Key trends in science and technology for the well-being of European aquaculture sector

1. GENERAL INFORMATION: location, duration, agenda, attendance and networking balance

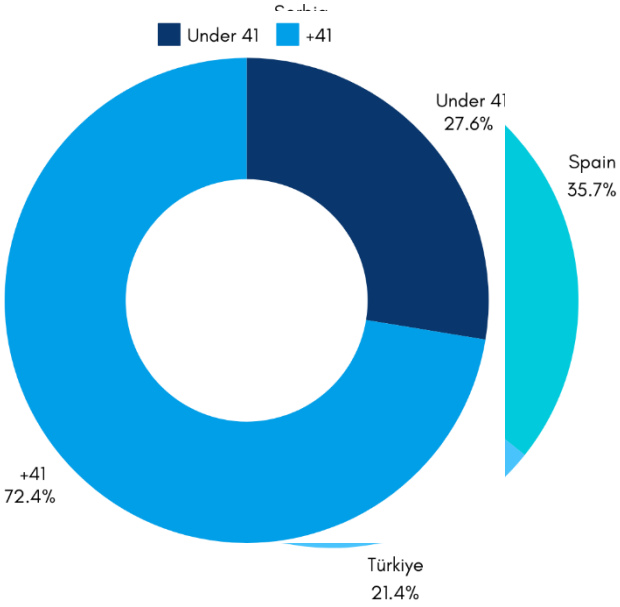
During April 17th and 18th, the 1st High-Performance Workshop of the Action took place at the Agri-Food Technological Institute of Extremadura (INTAEX-CICYTEX), located in the city of Badajoz (Spain). CICYTEX has several groups specialized in aquaculture, with dedicated labs and research facilities, and access to an experimental fish farm owned by the regional government of Extremadura. There is also an aquaculture ecosystem in the region and CICYTEX location.

With the aim of designing and coordinating the Workshop agenda, a Program Committee was established, formed by Miroslav Urosevic (MC and Working Group[1] 3, 4, 5 member), Dijana Blazhekovikj – Dimovska (MC and WG 2, 3, 5 member), Orkid Coskuner-Weber (Action Vice-Chair and WG 5 member), Theo Zacharis (WG 4, 5 member), Anna Toffann (MC and WG 1 member) and Eva García Muntión (Action Chair and WG 5 leader). On the other hand, Claudia Fincias Antolín, appointed as *Virtual Networking Support* for Period 1 of the Action, was responsible for launching the "Call for Speakers", a document that collected all presentation requests for the Workshop. These requests were reviewed by the Program Committee, and based on them, an agenda for the event was crafted, ultimately approved by the Management Committee.

The Workshop was attended by 29 participants, with 24 present in person and 5 joining live online by Teams. Of the total attendees, 35.7% were Spanish, followed by 21.4% from Turkey, and 10.7% from Italy. Attendees from Israel and Norway accounted for 7.1% each. The remaining participants hailed from Ireland, Croatia, Macedonia, Greece, and Serbia, with each contributing 3.6% to the total.

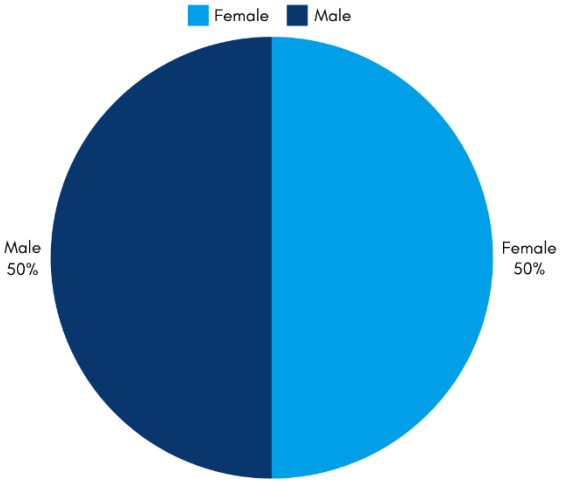
[1] WG 1. Biomolecular solutions for water prophylaxis and biosafety. Leader: Dr. Hilal Ay
WG2. Biomolecular solutions as alternative methods and tools for fish-farm production. Leader: Dr. Ivana Giovanna Zupičić.
WG3. Fish welfare, horizontal Working Group. Leader: Dr Rajat Nag.
WG4. Sustainability insights, for leveraging R&I. Leader: Dr Carlos Mazorra de Quero.
WG5. Informed creativity, complementary Working Group. Leader: Ms Eva García Muntión.

On the other hand, considering the recorded age data, 21 attendees are over 41 years old, accounting for 72.4%, compared to 27.6% of participants under 41 years old. Additionally, half of the participants were women, and the other half were men.



Attendance distribution by countries

Attendance distribution by age



Attendance distribution by gender

2. FIRST DAY OF THE WORKSHOP: Wednesday, April 17th, 2024

Eva García Muntión conducted the opening ceremony, welcoming all attendees and announcing the agenda for the Workshop. The first block of activities consisted of presentations involving 8 different speakers addressing various topics grouped into 4 blocks: “Risks for fish and aquaculture”; “New treatments for fish health”; “Industrial practice and one keynote presentation on computational approaches and big data analytics in improving fisheries and aquaculture.”

“Risks for fish and aquaculture”, this first block was chaired by Francesco Pascoli (WG 3), and Rajat Nag (WG 3 Leader and member of WG 4) was the first to present on "Need for microbial and chemical risk assessment in aquaculture”. This review emphasizes the importance of assessing and mitigating these risks. It outlines common microbial pathogens and chemical contaminants in aquaculture,

highlighting their sources and associated health risks. Existing risk assessment methodologies and the need for comprehensive frameworks integrating microbial and chemical risk assessment into aquaculture management are discussed. Mitigation strategies include best practices for minimizing contamination and reducing chemical inputs. Collaboration between disciplines is crucial for addressing complex aquaculture challenges. Overall, the review stresses the necessity of ongoing research and innovation to ensure the safety and sustainability of aquaculture operations in the face of microbial and chemical risks.

Following him, Izzet Burcin Saticioglu (WG 1, 2 and 3) gave a presentation titled "A review of bacterial disease outbreaks in rainbow trout (Oncorhynchus mykiss) reported from 2010 to 2022." Outbreaks of bacterial infections in aquaculture have emerged as significant threats to the sustainable production of rainbow trout worldwide. Understanding the dynamics of these outbreaks and the bacteria involved is crucial for implementing effective management strategies. This comprehensive review presents an update on outbreaks of bacteria isolated from rainbow trout reported between 2010 and 2022.

After each presentation, a question round was opened where attendees exchanged numerous opinions and impressions on the topics discussed.

As a break before the second session of presentations, there was a 30-minute break for all attendees to speak and get to know each other better. Following the pause, the presentation block titled "New treatments for fish health," led by Stojmir Stojanovski (MC member and WG 1, 2, 3 and 4), began. Öznur Diler (WG 1) gave a presentation titled "Antibacterial and Antibiofilm activity of Origanum onites and Mentha spicata subs tomentosa essential oil nanoemulsions against bacterial fish pathogens."

The aim of the current study was to determine the antimicrobial and antibioflm activities of two different aromatic plants (Origanum onites, Mentha spicata subs. tomentosa) essential oils, and their nanoemulsion formulations against common fish pathogens, Vagococcus salmoninarum, Staphylococcus warneri, Pseudomonas aeruginosa, Vibrio parahaemolyticus, Aeoromonas veronii, Vibrio alginolyticus, Yersinia ruckeri, and Lactococcus garvieae.

Following this, Andrea Marsella (WG 1) spoke about "Vaccination in fish aquaculture." Vaccines represent a valuable tool with several applications and effects for the aquaculture industry. Vaccination should be part of biosecurity programs applied at the farm level to reduce disease outbreak impact and the risk of spreading the infection to neighboring establishments. More importantly, in case of endemic disease, vaccines reduce economic losses related to mortality, treatment with veterinary medical products and other indirect losses linked to outbreaks. Especially for viral diseases, vaccines may represent the only solution to maintain the profitability of an activity. Availability of vaccines for the

disease of interest is critical issue affecting aquaculture. where vaccines have been developed, this availability has improved productions and reduced antimicrobials usage, increasing aquaculture sustainability.

After this second block of presentations, Orkid Coskuner-Weber spoke about "Computational Approaches and Big Data Analytics in Improving Fisheries and Aquaculture." Genomic research has contributed towards beneficial technologies for aquaculture. Existing technologies, like next-generation sequencing, generate oceanic data which requires analysis using appropriate tools. Quantum machine learning and bioinformatics are rapidly evolving fields that integrate gene-based information and computational technology to produce new insights. The aim of this talk was to present various aspects of diverse quantum machine learning and bioinformatics tools, with special emphasis on their practical application in the aquaculture industry.

Continuing with the event agenda, all participants moved to the CICYTEX-INTAEX[2] laboratories for a guided tour of their facilities. During this activity, they were able to see firsthand the work of characterization, valorization, and transformation of food products carried out at the Institute. The work areas of this center cover the production and transformation activities of the agri-food industry in Extremadura. There are seven areas: Oil, Biotechnology and Sustainability, Meat and Meat Products, Oenology, Dairy, Postharvest, and Vegetables. Additionally, the center has cross-disciplinary laboratories in Microbiology, Chromatography, Sensory Analysis, and Food Technology. They also perform general administrative functions as well as Project Management, Industrial Facilities Management, and Technology Transfer to companies and the sector in general.

The aim of their work is to increase the competitiveness of the agri-food sector by promoting innovation and technological development in SMEs, improving the quality of their products to meet the demands of discerning consumers.

Following a lunch break, the day concluded with a collaborative activity, called “Delphy Analysis”, by all participants to create a technology foresight aimed for enhancing knowledge of biomolecular solutions for the well-being of European aquaculture sector. This activity was coordinated by Eva García Muntión.

3. SECOND DAY OF THE WORKSHOP: Thursday, April 18th, 2024

The second day of the event, Thursday, 18th April, began with the third block of presentations, grouped under the theme of “Industrial practice”. The first speakers were David Tejerina Parrado and María José

[2] https://cicytex.juntaex.es/intaex-descripcion

Rodríguez Gómez, both researchers of INTAEX, with the presentation titled "Improving and Diversification of Tench (Tinca tinca) Cultivation". The research team of CICYTEX together with researchers from the University of Granada (Spain) and the aquaculture centre (Centro de Aquicultura Vegas del Guadiana) belonging to the Junta de Extremadura, have recently carried out a study in which the inclusion of Lupinus albus and/or sunflower oil as ingredients in diets formulated for juvenile rainbow tench was evaluated. Thus, the effect on flesh quality and other physiological aspects of the fish were analysed. In addition, and as proposals for the diversification of tench farming, prepared dishes were prepared, and the effect of volatile antimicrobial compounds was studied to improve fresh storage. The findings of this study offer promising options for tench farming and diversification.

Representing INTAEX, Bruno Navajas Preciado also gave a presentation titled "Unlocking the Hidden Potential of Fishery Waste". These wastes are often ignored and have valuable potential as raw materials that are rich in high-value metabolites. Instead of being relegated to landfills or oceans, the application of biotechnological techniques and/or clean chemistry results in a sustainable alternative for the sector, transforming waste into high-value compounds. This study applies in vitro knowledge to obtain a real technological transfer to a sector of enormous impact on the world economy, offering extraction conditions that can be easily integrated into the industry, reducing costs, and supporting economic development in fish processing.

To conclude this third session of presentations, Sofía Costa Lima (WG 2 and 4) spoke on "Advanced Nanotechnology for Functional Nutrition in Aquaculture". Billions of individuals rely on fish and other aquatic foods for essential nutrients crucial to prevent malnutrition, diseases as heart disease and stroke, and contribute to overall well-being. In a historic milestone, aquaculture production has now surpassed wild harvests from the world's inland and marine waters, marking the first time in history. Currently, more than half of the world's fish and other aquatic food for human consumption comes from aquaculture. Thus, aquaculture ensures a sustainable and reliable supply of fish, helping to meet the nutritional needs of a growing global population while preserving wild fish stocks and protecting marine ecosystems. In high-density intensive farming, fish may experience stress and disease susceptibility, leading to reduced yields. This drives the need for disease management strategies beyond antibiotics or even vaccination.

After a brief coffee break, all attendees were transported by bus to the "Las Vegas del Guadiana" Aquaculture Centre, an institution belonging to the Junta of Extremadura, for a technical tour guided by its staff. There, they were able to see firsthand the centre's main work: the breeding of warm water species. The facilities were originally designed to produce fry and fingerlings of species of sporting interest, such as carp and largemouth bass. This initiative arose from the need to restock national water

bodies, in support of other national centres such as El Palmar (Valencia), Aranjuez (Madrid), and Plasencia del Monte (Huesca).

Currently, it engages in research and development activities focusing on artificial reproduction techniques and larval feeding in native cyprinid species. In this regard, the Government of Extremadura has made a significant effort, investing in the Aquaculture Centre to adapt the facilities to the requirements of the newly incorporated species. As a result, the centre now has two incubation and fry rooms, a new research laboratory, and a secondary culture room. These facilities offer great potential for development and adaptation to new requirements.

The species currently under investigation are: Tinca tinca (tench), Iberochondrostoma lemmingii (jarabugo), Squalius alburnoides (calandino), Barbus comiza (Iberian barbel), Barbus microcephalus (small-headed barbel), Squalius pyrenaicus (nase), and Pseudochondrostoma willkommii (Guadiana boga).

After this visit to the Aquaculture Centre and a lunch break, the Workshop concluded with a co-working session for the editing of a book based on the event's results and Bioaqua's interests. This session was chaired by Miroslav Urosevic, Orkid Coskuner-Weber, and Eva García Muntión.

During this activity, valuable and important conclusions were drawn to organize the initial steps in writing the book. Firstly, a provisional title "Biomolecular Solutions for Aquaculture" was established, along with a structure comprising 10 chapters of 3.000 words each, with the following titles and possible responsible individuals for each:

- What is a biomolecular solution?
- Natural compounds
    - For fish welfare and stress
    - For disease prevention
    - For disease treatment
    - For improved performance
- Sensors and improved detection methods
- Computational approaches
- Functional fish feed
- Vaccines
- Phagotherapy
- Risk assessment for innovative biomolecular solutions
- Future developments (completed with Delphi Analysis results)

- Needs for new policies in fish farming

Following this 1st High-Performance Workshop, interaction among all Action members has significantly increased in a very positive manner. The registration rate for upcoming webinars is much higher, and everyone wants to participate in the activities scheduled for the first period of the Action. Additionally, a very friendly community atmosphere has been generated in which everyone is highly involved.

4. ANNEX: links and images

Oficial Action website: https://bioaqua-cost.eu/

Oficial Workshop video: https://youtu.be/cbQircPZlMA

BIOAQUA'S 1ST HIGH-PERFORMANCE WORKSHOP

AGENDA DAY 1: 17TH April 2024

09:00 – 09:30	Welcome
09:30 – 10:30	Presentations • **Session 1: Risks for fish and aquaculture** ○ Chaired by: Francesco Pascoli ○ Speakers: 09:30 ▪ Need for microbial and chemical risk assessment in aquaculture, by Rajat Nag. 10:00 ▪ A review of bacterial disease outbreaks in rainbow trout (Oncorhynchus mykiss) reported from 2010 to 2022, by Izzet Burcin Saticioglu.
10:30 – 11:00	Coffee break
11:00 – 12:00	• **Session 2: New treatments for fish health** ○ Chaired by Stojmir Stojanovski ○ Speakers: 11:00 ▪ Antibacterial and Antibiofilm activity of Origanum onites and Mentha spicata subs tomentosa essential oil nanoemulsions against bacterial fish pathogens, by Öznur Diler. 11:30 ▪ Vaccination in fish aquaculture, by Andrea Marsella.
12:00 – 12:30	**Keynote presentation:** Computational Approaches and Big Data Analytics in Improving Fisheries and Aquaculture, by Orkid Coskuner-Weber.
12:30 – 13:30	**Visit to INTAEX laboratories**
13:30 – 14:30	Lunch break
14:30 – 17:00	**Co-work towards a technology foresight exercise for enhancing knowledge of biomolecular solutions for the well-being of European aquaculture sector.** Chaired by Eva García Muntión.

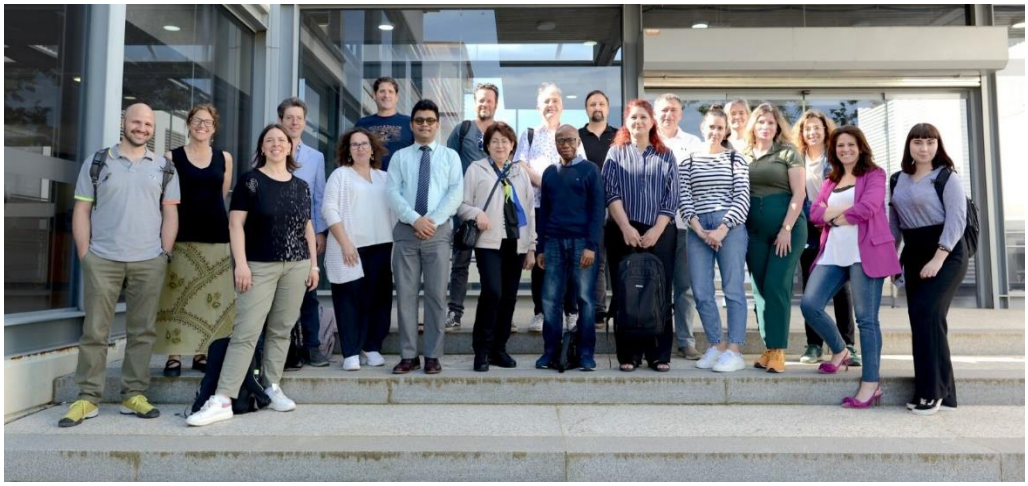
Agenda 1st day: 17th, April 2024

BIOAQUA'S 1ST HIGH-PERFORMANCE WORKSHOP

AGENDA DAY 2: 18TH April 2024

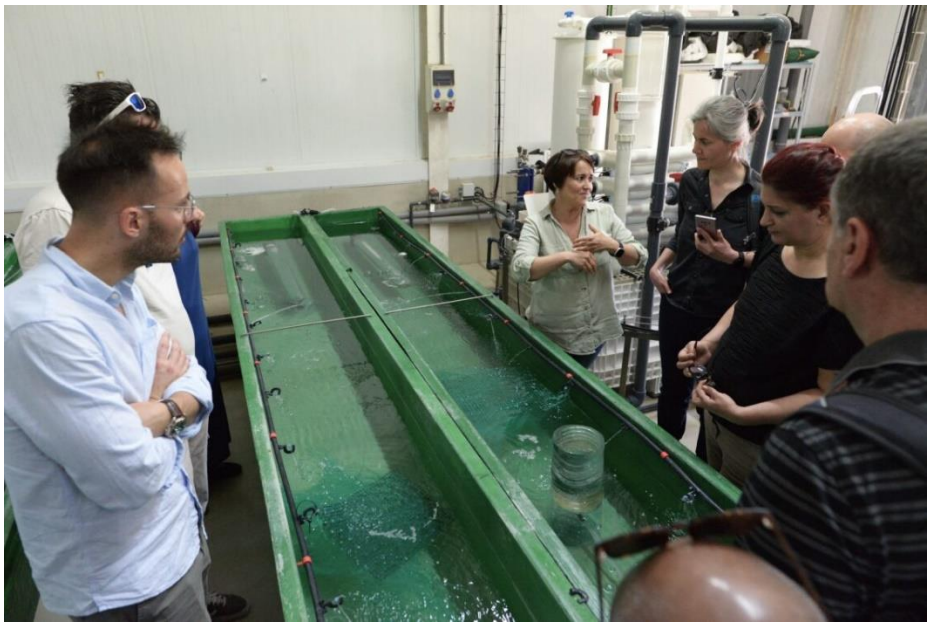
09:00 – 11:00	Presentations • **Session 3: Industrial practice** ○ Chaired by: Simon Weli ○ Speakers: 09:00 ▪ Improving and diversification of tench (tinca tinca) cultivation, by Mª José Rodríguez Gómez / David Tejerina Barrado. 09:30 ▪ Unlocking the Hidden Potential of Fishery Waste: Transformation to Innovative Sustainable Biopolymers, by Bruno Navajas Preciado. 10:00 ▪ Advanced Nanotechnology for Functional Nutrition in Aquaculture, by Sofia Lima.
10:30 – 11:00	Coffee break
11:00 – 14:00	**Visit to experimental fish farm**
14:00 – 15:30	Lunch break
15:30 – 17:00	**Co-work for the edition of a book from event's results and Bioaqua's interest.** Chaired by Miroslav Urosevic, Orkid Coskuner-Weber and Eva
17:00 – 17:30	Closure

Agenda 2nd day: 18th, April 2024

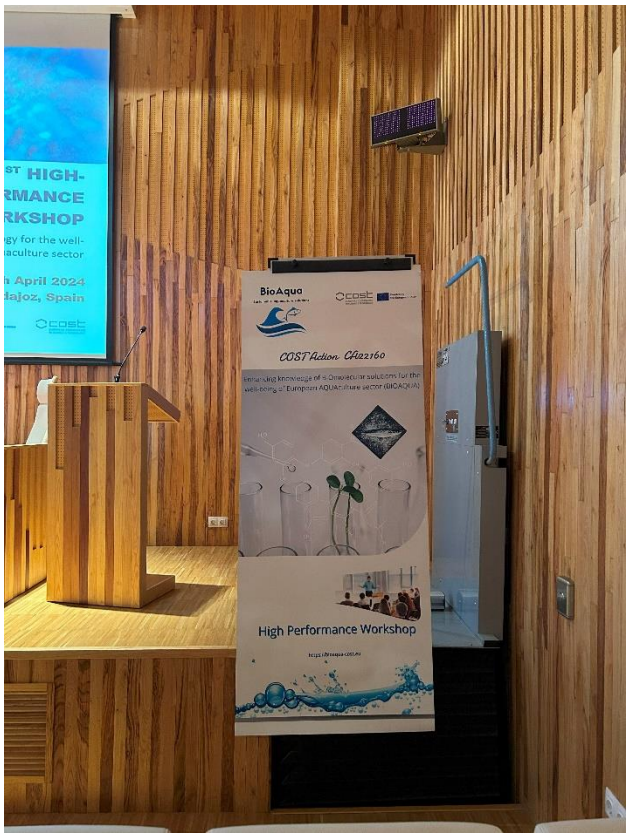


Group photo of attendees

Delphi Analysis. Collaborative activity by all participants to create a technology foresight aimed for enhancing knowledge of biomolecular solutions for the well-being of European aquaculture sector.



Guided tour of the facilities at the "Las Vegas del Guadiana" Aquaculture Center.



BioAqua´s roll-up used during the WorkShop.

Group photo of attendees in "Las Vegas del Guadiana" Aquaculture Center