

AQUA FISH

WWW.AQUAFISHPROJECT.EU

BLUE CIRCULAR INNOVATION EVENT

From Aquaculture to Sustainable Food Solutions

DATE

24 September 2026

VENUE

IPMA, Algés



Interreg
Atlantic Area



Co-funded by
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EVENT BY



IPMA
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Atmosfera

PARTNERSHIP



S²AQUA
Laboratório Colaborativo
Sustainable and Smart Aquaculture

Objectives

Seafood product valorization

- Promote sustainable production and consumption of new seafood products.
- Use a circular economy approach, making use of by-products and by-catches from aquaculture and fishing industries.
- Raise awareness among consumers and producers about the need for policies that reduce food waste (the “zero waste” approach).

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AQUAFISH

BLUE AND GREEN ENVIRONMENT

AQUAFISH 0.0

Improving the acceptance and social awareness in the consumption of sustainable marine food products developed under the zero-waste philosophy

ERDF funding
1658.165,84€

Total budget
2.210.887,79€

Calendar
From Nov 2023 to Oct 2026

Partnership

PARTNERS:



ANDALUSIAN AQUACULTURE
TECHNOLOGY CENTRE



Diputación
de Cádiz



CEEI
Centro Europeo de
Empresas e Innovación



IPMA
Instituto Português
do Mar e da Atmosfera



WestBIC



Technopole
Quimper-Cornouaille



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Sustentabilidade and Smart Aquaculture



esiea



L'INSTITUT
agro Rennes
Angers



Parditi

Associated:



BIM
Ireland's
Seafood
Development
Agency



KIP
Knowledge to
Improve Professional
Incomes



Project challenges

R&D: Develop new food products using by-products and unwanted catches. Pilot actions to support sustainable aquaculture and low trophic level species.

Raise public awareness about the circular economy, both for responsible consumption and reducing waste.

Support better policies and regulations to help develop and introduce these new products.

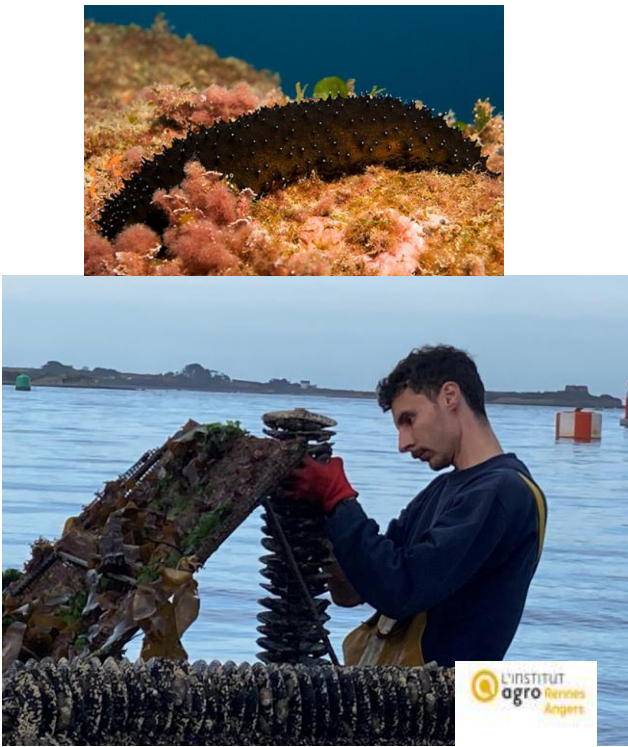


Aquaculture cultivation techniques

Pilot actions (IMTA cultivation and low trophic species)



Paracentrotus lividus and *Ulva* sp.

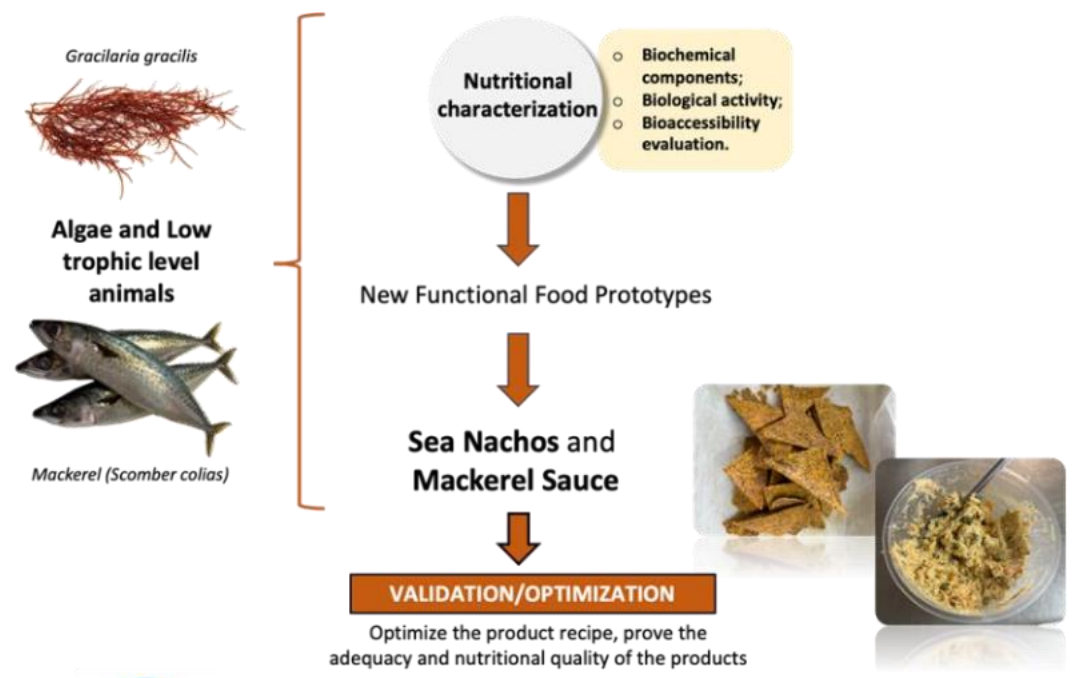


Holothuria foskopii and *Haliotis tuberculata*



H.arginensis and *Ulva* sp.

Innovative products



Tuna Paté



Sea urchin Paté



Next generation engagement

Gastronomic recipe challenges



Educational activities



Presence in gastronomic fairs



AQUAFISH Remote classroom



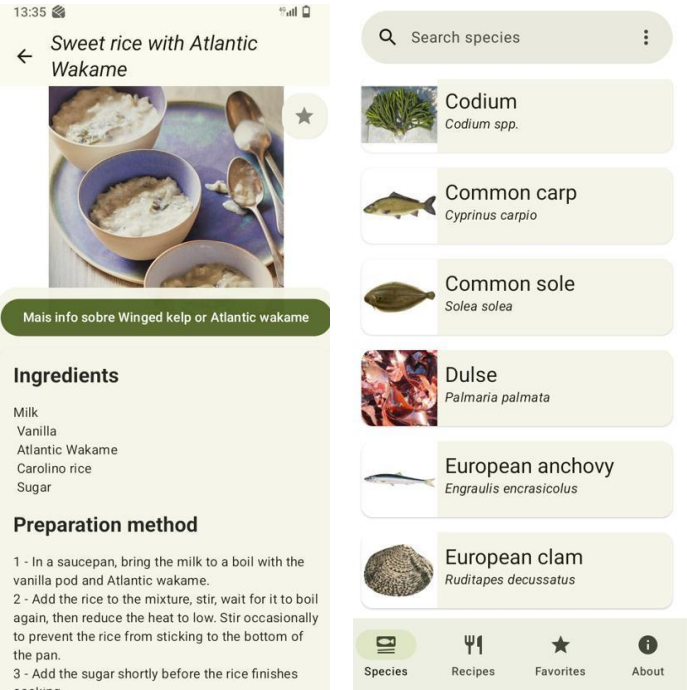
Social acceptance



SeaCHEF Virtual reality cooking game



AQUAFISH chef mobile app



// AQUACULTURE & FISHERIES 0.0

AQUAFISH0.0 project

Improving acceptance and social awareness in the consumption of sustainable marine food products developed under the zero-waste philosophy

[LEARN MORE](#)

**IMPROVING
THE ACCEPTANCE**
and social awareness in the
consumption of sustainable
MARINE FOOD PRODUCTS
developed under the
**ZERO-WASTE
PHILOSOPHY**





Together,

these achievements leave a legacy of knowledge, educational material, practical tools and collaborative solutions that will continue supporting the transition towards a more **sustainable, resilient and circular blue economy**.

Healthy oceans
Sustainable food
Stronger communities



RESULTS

CONCLUSIONS

FINAL DOSSIER

AQUAFISH

Improving the acceptance and social awareness in the consumption of sustainable marine food products developed under the zero waste philosophy

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THE PROGRAMME

Interreg Atlantic Area programme

4 countries

- SPAIN
- FRANCE
- PORTUGAL
- IRELAND

interreg Atlantic Area

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Interreg Atlantic Area 2021-2027 supports transnational cooperation in the Atlantic regions of four countries: Portugal, Spain, France and Ireland.

In this programme, the commitment with the Atlantic regions is renewed in the support of innovative initiatives that contribute to the growth of this area, solving common challenges across border through the implementation of joint actions, exchange of good practices and contribution to new or current policies.

AQUAFISH.0 brings together partners from Spain, Portugal, France and Ireland, reflecting the transnational cooperation at the heart of the Interreg Atlantic Area Programme.

IRELAND

WESTBIC Innovation & Management Centre
GUS Y&A WestBIC
BIM (Associated partner)
BIM Ireland's Seafood Development Agency

SPAIN

CTAGIA Andalusian Aquaculture Technology Centre
CEEBAÑA DE CÁDIZ Fundación Sábila de Cádiz para el Desarrollo Económico
DIPUTACIÓN DE CÁDIZ Instituto de Empleo y Desarrollo Tecnológico

PORTUGAL

IPMA Instituto Português do Mar e da Atmosfera
ISAGUA Laboratório Colaborativo Associação para uma Aquacultura Sustentável e Inteligente
ARDITI Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação
KPT (Associated partner) Laboratório Colaborativo do Turismo e Inovação

The programme supports cooperation in 4 priorities and 8 specific objectives, based on the outcomes of a territorial analysis

AQUAFISH.0 falls under Priority 2 of the Interreg Atlantic Area Programme 2021-2027, Blue and Green Environment, and specifically contributes to objective RS02.6: "Fostering the transition to a circular and resource-efficient economy." This objective aims to promote more sustainable production models that reduce waste generation, optimize the use of raw materials, and foster innovation in value chains linked to the blue economy.

Priority 2 of the Interreg Atlantic Area Programme 2021-2027, Blue and Green Environment

RELEVANCE

Current developments in the world, and particularly in the Atlantic region, are leading to a paradigm shift in the way we produce and consume food. The current environmental situation is encouraging European countries to rethink how we produce and consume food. Reducing pressure on marine resources requires more sustainable approaches that can help generate aquatic ecosystems. Fisheries and aquaculture are important traditional activities in the Atlantic. However, their production processes also generate large amounts of by-products and by-products. These resources are often discarded or used for low-value applications, even though they could be transformed into new, high-value food products. On the same line, there is a need to promote more environmentally friendly practices and circular business models in the fisheries and aquaculture sectors. This means looking for the correct design of production and fishing using circular waste and making better use of available resources.

The innovation of the AQUAFISH.0 project lies in the transformation of conventional linear and value chains into an integrated circular food system. Rather than focusing on a single stage of the innovation process, the project addresses the entire pathway required to deliver sustainable marine resources that meet society's food products for human consumption. It combines resource assessment, product development, sustainable production, market validation, economic feasibility, regulatory compliance and consumer acceptance within a single framework.

SUSTAINABILITY

IRREGULAR ECONOMY
ZERO-WASTE PHILOSOPHY
TRANSFERRABILITY TO OTHER REGIONS
SCALABILITY
CONSUMER AWARENESS
NEXT GENERATION ENGAGEMENT

The project initiative aims to demonstrate practical circular solutions through pilot systems, helping businesses and other stakeholders understand their benefits and encouraging changes towards more sustainable practices.

The project outcomes are highly transferable across the Atlantic and other regions, providing a scalable model for the sustainable transformation of their economic resources. Additionally, it is aligned with the objectives of the European Green Deal, the European Strategy for a Sustainable Blue Economy, regarding environmental protection, resource efficiency, and food sustainability, by applying circular economy principles in the fisheries and aquaculture sectors.

IMPACT

RESEARCH AWARENESS
PRODUCT DEVELOPMENT
SUSTAINABLE PRODUCTION
MARKET VALIDATION
ECONOMIC FEASIBILITY
REGULATORY COMPLIANCE
CONSUMER AWARENESS

Understanding and disseminating information on the project and its results.

Designing, developing and validating high-added-value products.

Implementing sustainable production and circular models.

Validating market and commercial viability of the products.

Assessing economic feasibility and profitability of the project.

Ensuring regulatory compliance and food safety.

Building trust and promoting innovation among stakeholders.

PROJECT BACKGROUND

Providing sufficient food for the growing human world population is one of the biggest challenges of our time. Reducing food loss and waste and ensuring the sustainability of food systems are key challenges and generate benefits for economies, consumers, and for the environment.

Using less, thousands of tonnes of maritime marine resources are discarded or remain underutilised across Europe. Bycatch, undervalued processing, by-products and low-commercial-value species, often even reach our plates, despite their nutritional and economic value.

The AQUAFISH.0 project aimed to transform an environmental challenge into an opportunity for social and economic development in the Atlantic region. The project addresses one of the most urgent challenges facing marine value chains: the waste of bycatch, species of low commercial value, and by-products that, despite their nutritional and economic potential, are frequently discarded or used for low-value purposes.

Recognising the key bottlenecks detected in the food waste loss of bycatch, the project focuses on the value of bycatch and by-products generated by the aquaculture and fisheries industries, more sustainable production business models and innovative products, social perception of innovative seafood products, the economic feasibility of using by-products in business models, the regulatory framework in each participating country for launching innovative seafood products into the market, and social awareness and next-generation engagement.

To contribute to these results, the project created a multidisciplinary approach, not only focusing on the scientific and technological aspects of the matter but also involving socio-economic aspects and education.

The uptake of circular economy approaches in fisheries and aquaculture in Atlantic and Mediterranean coastal communities remains limited due to low awareness, insufficient demonstration of viable business models, and a lack of practical examples capable of convincing environmental sustainability with economic competitiveness. AQUAFISH.0 has addressed the regulatory, economic, and social barriers that limit the implementation of circular models in fisheries and aquaculture, developing tools and methodologies that can be applied to other European regions.

PROJECT FACTS

The AQUAFISH.0 project aimed to transform an environmental challenge into an opportunity for social and economic development in the Atlantic region.

39 MONTHS - 4 COUNTRIES - 12 ORGANISATIONS

DURATION

39 months
From October 2022 to January 2027

PROGRAMME

INTERREG ATLANTIC AREA

TOTAL PROJECT BUDGET

2,380,000 €
with an amount of 1,800,000 € from funding of 100% ERDF

LEAD PARTNER

CTAGIA
Andalusian Aquaculture Technology Centre

10 PARTNERS

From Spain, Portugal, Ireland and France:

2 ASSOCIATED PARTNERS

BIM, BIC

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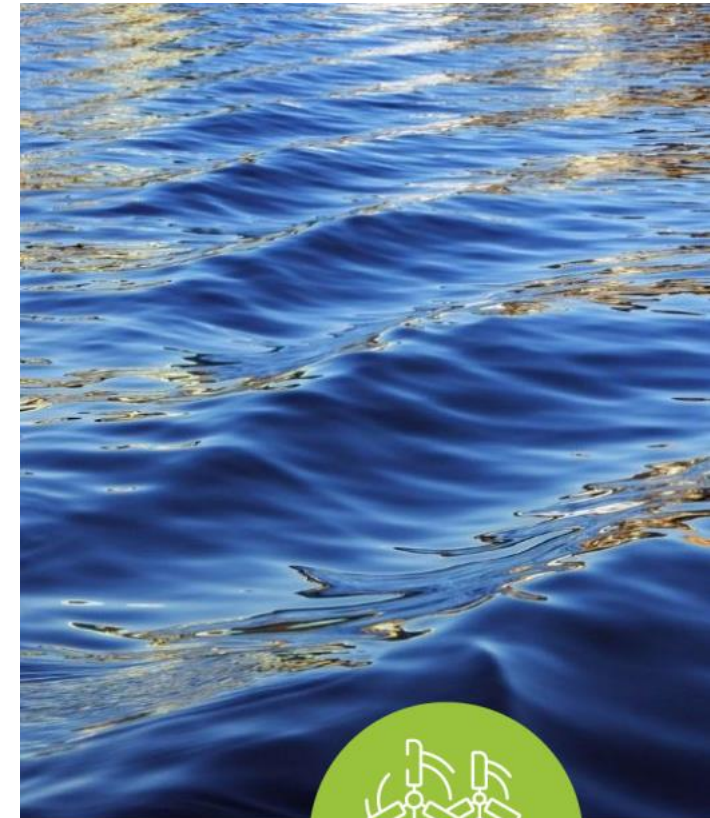
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WP1 Activity 1

**Inventory of by-products and bycatch volumes in
aquaculture and fisheries**

Technopole Quimper Cornouaille

Methodology

Inventory of by-products and bycatch volumes available in four countries

Direct methodology : survey

Indirect methodology : using conversion coefficients applied to landing volumes, transformation rates etc



Value chain of by-products and bycatch : barriers and levers



Case study

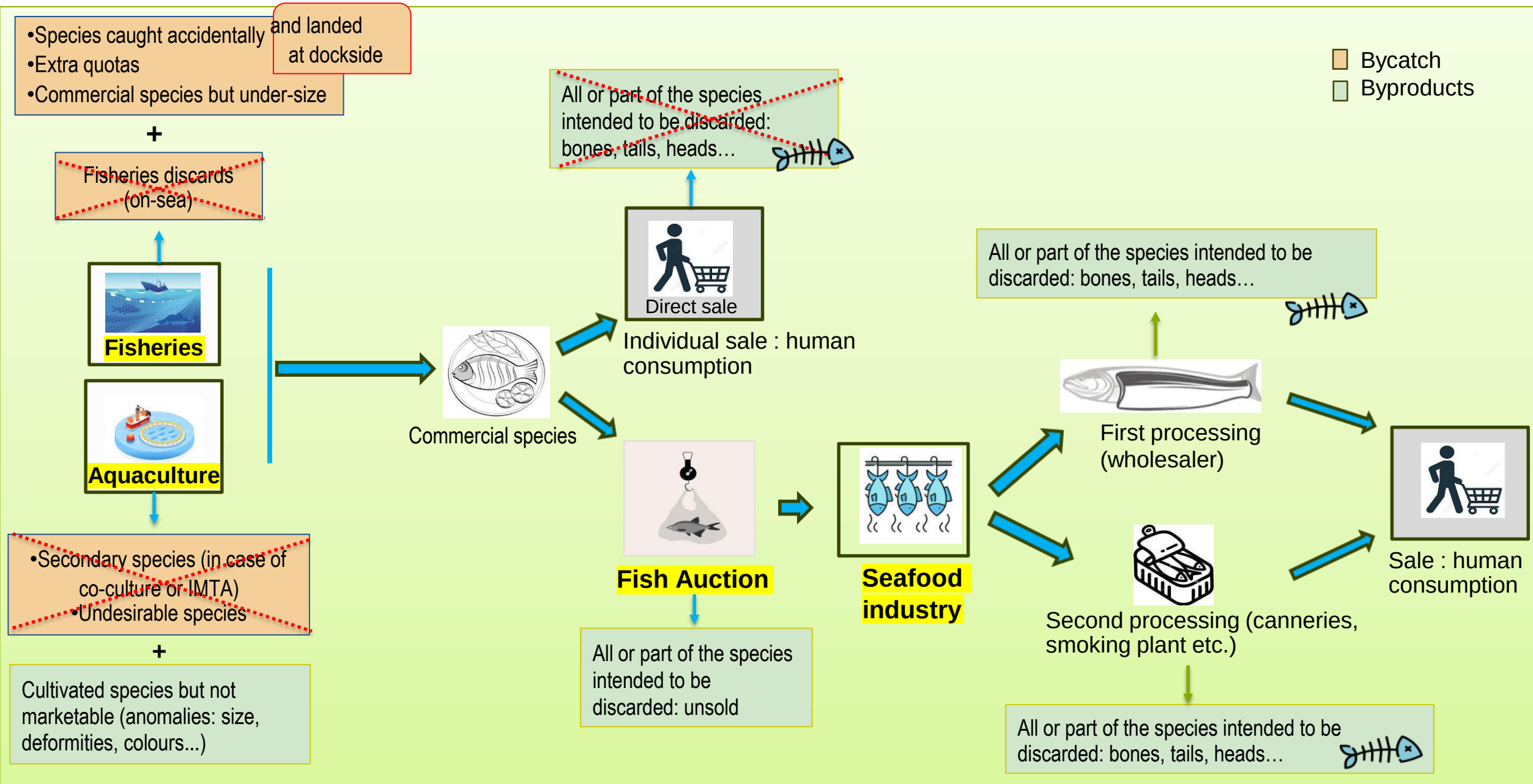
Focus Groups



Guidelines for the registration of by-products



Definitions used In Aquafish estimation biomass volumes



RESULTS : Marine by-product and by-catch volumes by country

➤ **30 to 50% of the total weight of catches become by-products after processing**

	Country	By-products (annual estimate)	By-catch (landed at port)	Observations on the data
	France	240 149 tonnes (national data 2018), including 62,936 tonnes in Brittany	Unknown (no precise data available)	The estimate includes processing waste and unsold auction items
	Spain	~60,000 tonnes (indirect estimate via processing companies)	3 336 tonnes (2022 data)	By-catch has decreased since the landing obligation due to illegal discards at sea
	Portugal	~41 778 tonnes (2022 data)	Almost nil (most is discarded at sea)	By-products mainly come from canning and freezing industries
	Ireland	21 667 to ~138 000 tonnes (estimates vary by study)	Unknown (estimated only through on-board observation)	Estimation gaps highlight the difficulty in collecting precise data

➤ **We have an incredibly rich resource, but we must get better at tracking it.**

Barriers / Obstacles

- ✓ **Access and reliability of data:** There is a critical difficulty in accessing recent and precise data, often protected by statistical confidentiality or dispersed among private actors.
- ✓ **Logistics and costs:** The geographic dispersion of collection points and the need for expensive refrigeration systems make recovery barely profitable for small volumes.
- ✓ **Regulatory constraints:** Strict hygiene standards often prevent the use of products intended for animal feed in human consumption on the same production line.
- ✓ **Social acceptability:** Many consumers are still hesitant to buy foods explicitly labeled as containing “by-product” due to false ideas about food safety.
- ✓ **Impact of quotas:** In Spain, fishermen are reluctant to land accessory catches because they are deducted from their capture quotas, thereby reducing their profit.
- ✓ **Energy intensity:** Transformation processes (drying, hydrolysis) are energy-intensive, which weighs on profitability given the rise in energy prices.

Levers / Drivers of Success

- ✓ **Circular economy and public aid:** European and national policies (such as EMFAF) provide subsidies and incentives for "zero waste" projects.
- ✓ **Technological innovation:** The development of new processes (such as enzymatic hydrolysis) allows the extraction of high-value molecules for nutraceuticals or cosmetics.
- ✓ **Diversification of markets:** Exporting to international markets (especially in Asia) offers more opportunities than the local market for certain types of by-products.
- ✓ **Cooperation among actors:** The creation of networks like the Seafood Innovation Network in Ireland promotes knowledge sharing and joint investments.
- ✓ **Valorization of underutilized species:** Promoting lesser-known species (such as redfish or skate) can transform potential accessory catches into valuable products.
- ✓ **B2B marketing:** It is identified as more effective to convince other businesses (using ingredients) rather than the end consumer, which requires less communication effort.

Conclusion / Recommendations



We need to **harmonize regulatory and definitions** across European borders to avoid confusion between the terms "by-product," "co-product," and "accessory catch".



We must **lift the opacity on data opacity** to improve access.



We must **optimize logistics and the cold chain** to preserve these highly fragile raw materials.



We must adapt infrastructure and skills on board, so that accessory catches can be used for human consumption (while preserving quality).



It is easier to prioritize Target B2B marketing to bypass psychological consumer barriers, including the notion of "waste": it is easier to convince an industrial player than to change the eating habits of the general public.



Valorization initiatives for marine co-products exist in the 4 countries, but they remain mainly oriented toward animal feed and less toward human consumption for the moment.



Merci

Gracias

Obrigada

Thank you

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Rozenn LE VAILLANT

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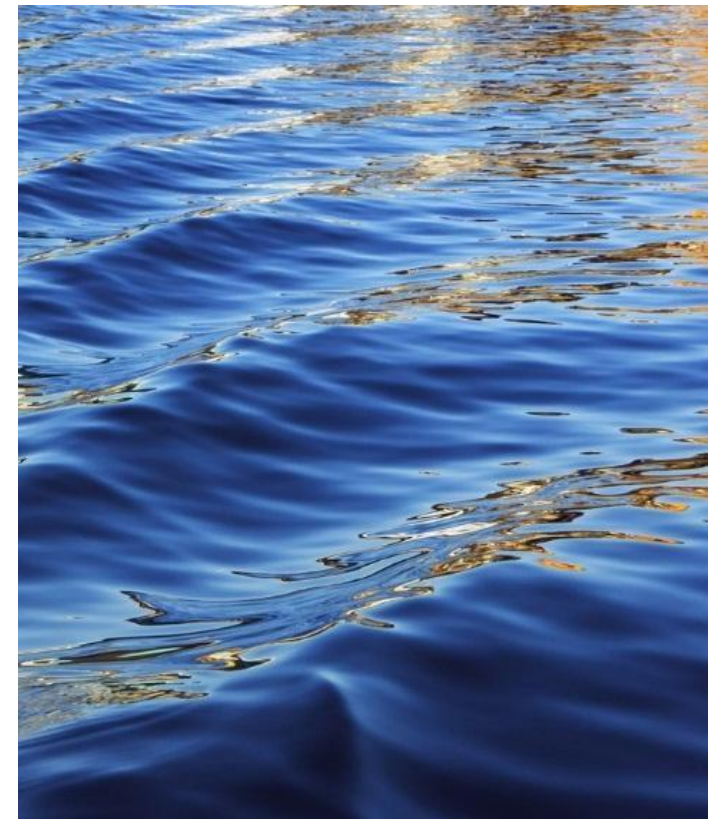
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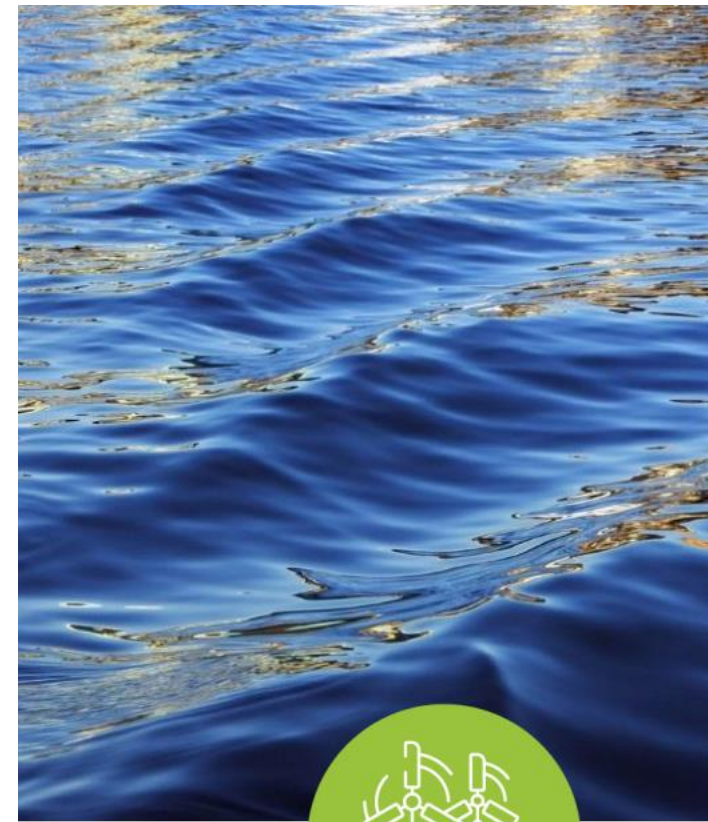
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CTAQUA



What products have been developed within the project for valorization?

CTAQUA – Aquaculture
Technology Centre

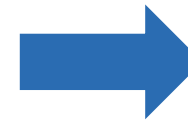
Innovative food products
from by-products and by-
catch



The Challenge: Resource Inefficiency

Current Issue: Heavy overexploitation of marine resources vs. high volume of wasted by-catch, low value commercial discards and by-products

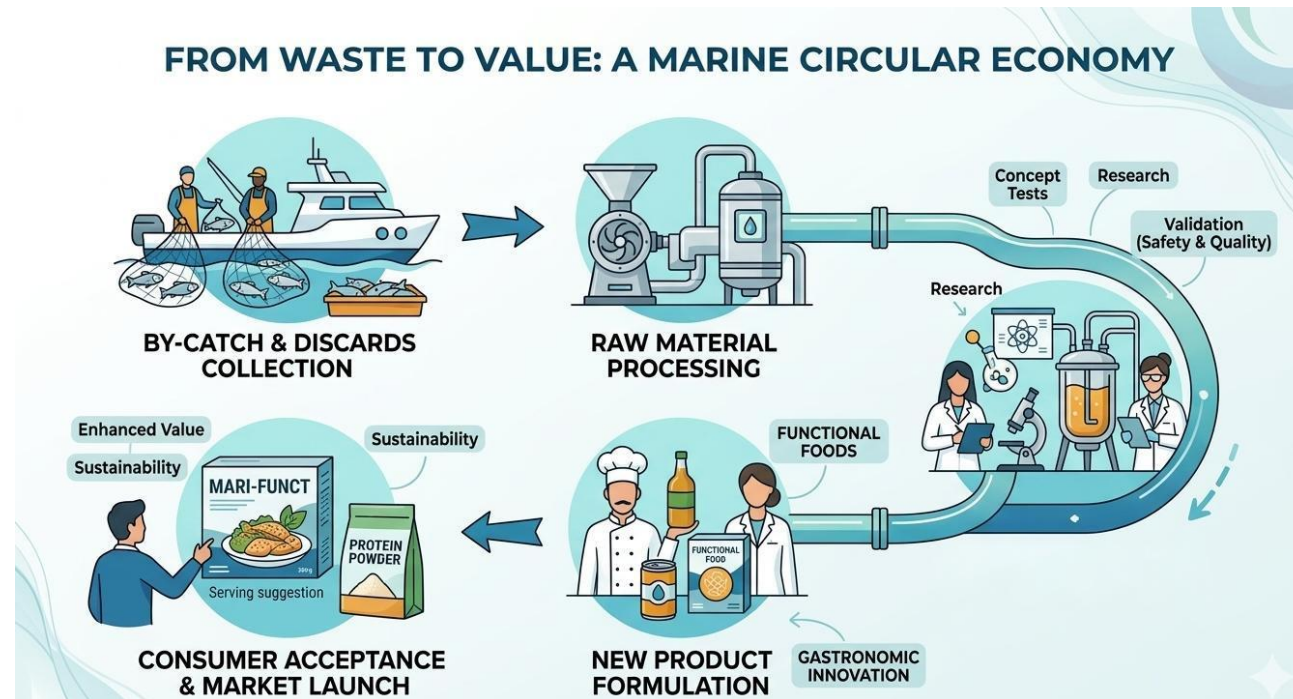
The Solution: Implementing **Circular Economy** principles to turn "waste" into added value



Innovative food products from by-products and by- catch

The objective : to analyze and develop different potential new functional food products taking by-products and by-catch from action 1.1 as raw material

- Concept ideas → Concept tests (R+D+I Pilot Plant)
- Validation of raw material, product transformation and prototypes (microbiological and organoleptic studies)
- Validation of possible packaging and storage
- Evaluation of acceptance
- Gastronomic evaluation (recipes with by-products and by-catch from this activity or other partners)



Objectives

10/2026

**4 NEW PRODUCTS
PROTOTYPES** using
by-products and by-
catch

CTAQUA → 2
IPMA → 1
S2AQUACOLAB → 1

CONCEPT IDEAS

(meetings → first ideas)



CONCEPT ANALYSIS

(why these raw materials and why these final products)



CONCEPT TEST

(4 new food prototypes)



VALIDATION

(microbiological, organoleptical, nutritional, physico-chemical, biological and/or functional studies, packaging)



CONCLUSIONS PANEL OF TASTERS

(evaluation of acceptance in
Transnational event)

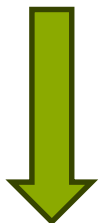
DELIVERABLES:
DEVELOPED PRODUCTS

CTAQUA

BY-CATCH



ANCHOVY



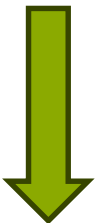
FISH
SEASONING



BY-PRODUCT



FISH COOK WATER
TUNA JERKY TRIMMINGS



TUNA PATE



IPMA

BY-CATCH / BY-PRODUCT



SEAWEEDS



SEA NACHOS



S2AQUACOLAB

BY-PRODUCT



TURBOT BY-PRODUCTS



SMOKED TURBOT BANGERS



Innovative food products from IMTA raw materials

IMTA: Nature-Inspired Aquaculture

Integrated cultivation of different, complementary species in one ecosystem.

Key Advantage: Simulates a natural food web → **Nutrient Recycling.**

Waste from species (e.g., Abalone) feeds others (e.g., Seaweed & Holothurians), creating a highly efficient, low-impact system.

- **Abalone:** Premium protein source.
- **Ulva Seaweed:** Mineral & Fiber-rich extractor. Protein source.
- **Holothuria:** Functional benthic cleaner (Calcium and collagen source).



DELIVERABLES: DEVELOPED PRODUCTS

From IMTA to Innovation

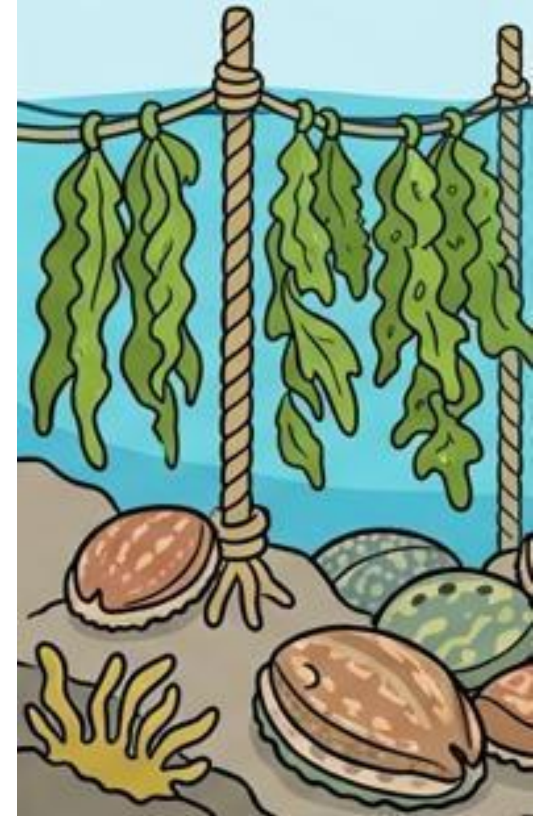
Functional Energy Bar

- Blend of Holothuria powder & Ulva Seaweed powder (functional compounds)
- Targeting performance nutrition with a unique marine source.

Culinary Diversity - Recipe Strategy:

Continuing the implementation of the 4 consumer-focused recipes.

Showcasing the culinary versatility and accessibility of fresh **Abalone** and **Holothuria** beyond traditional preparations.



DELIVERABLES: DEVELOPED PRODUCTS



DELIVERABLES: DEVELOPED PRODUCTS

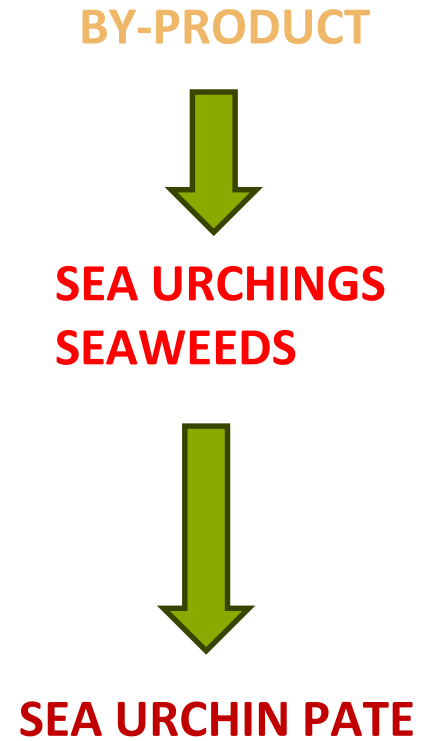
Case-studies of seaweed-based functional Food/Burger

Product rich in neuroprotective nutrients with the potential to prevent an/or delay cognitive decline associated with aging, such as Alzheimer's disease.



**DELIVERABLES:
DEVELOPED PRODUCTS**

S2AQUACOLAB



CONCLUSIONS

Providing visibility and identity: Turning "anonymous" or "discarded" ingredients into distinct products, breaking cultural and market barriers

Ensuring economic viability: Incentivizing sustainable practices by generating products with higher profit margins

Advancing towards "Zero Waste": Guaranteeing that every byproduct becomes the ingredient for the next process

Closing biological cycles: Ensuring nutrients return to the system, eliminating the concept of waste



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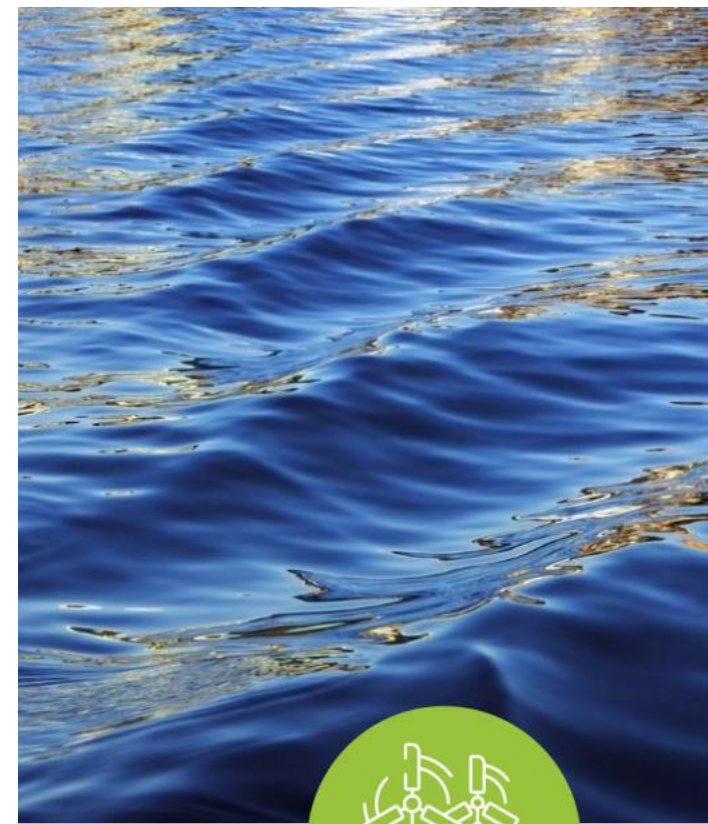
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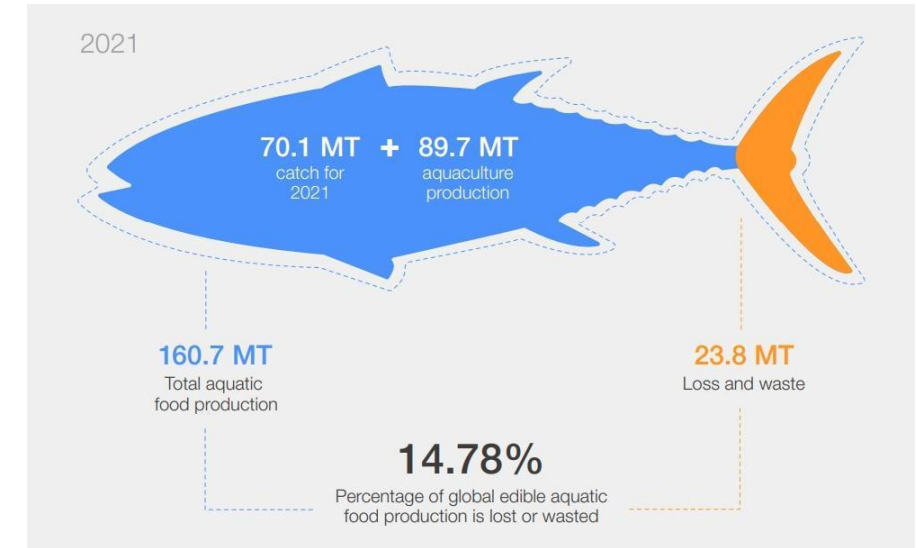
What insights have been gained from the pilot projects?

João Araújo- IPMA (PT)

Activity 1.3

Pilot actions: Search for sustainable
productive models and creation of
innovative food products

- Marine resources are heavily overexploited while vast amounts of by-catch and discards are wasted every day
- Too much of the ocean's resources are wasted — a circular economy turns by-catch and discards into value



Objectives

- ✓ Sustainable productive models and creation of innovative good products
- ✓ Complement the portfolio of innovative products with additional ones, in each of the territories of the project

From aquaculture systems to innovative food products: closing the loop



Validation of 4 new products/systems prototypes in the framework of AQUAFISH0.0

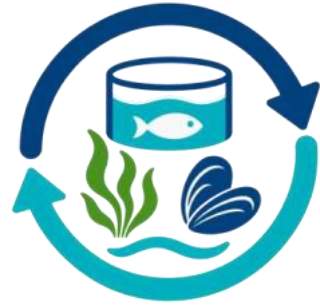
Pilot actions

- 1 Circular Aquaculture in Action: Seaweed Production in RAS and IMTA Systems
- 2 Sustainable Sea Urchin Farming through Seaweed-Based Feed
- 3 IMTA-Based Cultivation of Seaweeds and Sea Cucumbers for Sustainable Food Innovation
- 4 IMTA Co-Culture of Abalone and Sea Cucumbers for Sustainable Production and Product Innovation



1- Circular Aquaculture in Action: Seaweed Production in RAS and IMTA Systems

- Assess the potential for macroalgae production in integrated multi-trophic aquaculture (IMTA) and recirculating aquaculture systems (RAS), considering as co-product of marine fish farming



- ✓ Mean daily biomass gain reaches 24% (RAS/*Ulva* sp.)
- ✓ Great potential for RAS bioremediation systems, and a sustainable source of seaweed biomass



2- Sustainable Sea Urchin Farming through Seaweed-Based Feed

- To evaluate the use of algae co-produced in RAS and invasive algae in sea urchin feed



- ✓ *Ulva* sp. production on the pilot RAS system reliably supported about 3,000 sea urchins at a 5% daily intake rate
- ✓ *Ulva* sp. exclusively supports moderate growth. Incorporation into formulated feeds promotes great gonads development and good growth rates
- ✓ When added to inert feed (10%-20%), *Rugulopteryx okamurae* (invasive) promotes good growth and gonadal development



3- IMTA-Based Cultivation of Seaweeds and Sea Cucumbers for Sustainable Food Innovation

- 1- To evaluate the impact of different substrate and diet combinations on the growth of *Holothuria arguinensis* in a recirculating aquaculture system (RAS).



- ✓ The absence of sediment limited *H. arguinensis* growth, while mud and sand—alone or combined—were equally suitable despite mud's higher organic matter content
- ✓ Diet enrichment was key to *H. arguinensis* growth, with *Chaetomorpha* sp. and commercial feed combined with mud producing significantly greater growth than the control.



3- IMTA-Based Cultivation of Seaweeds and Sea Cucumbers for Sustainable Food Innovation

- 2- To assess the growth (%/day) and survival (%) at two locations in estuaries with different environmental conditions:



- ✓ Survival was 50% under subtidal and 56.7% under intertidal conditions. April was critical for both treatments following the environmental change, while temperature fluctuations made August unsuitable for intertidal farming.
- ✓ Intertidal cultivation briefly yields higher growth rates, whereas subtidal cultivation provides more stable results outside winter.



4- IMTA-Based Cultivation of Seaweeds and Sea Cucumbers for Sustainable Food Innovation

- Study the growth performance of a farm combining abalone and sea cucumbers with a monospecific abalone or sea cucumber farm
- Study the impact of sea cucumber growth (associated with abalone) as a function of density.



- ✓ Co-culture with *H. forskali* was feasible, did not affect abalone growth, and achieved >75% sea cucumber survival.
- ✓ Densities up to 77 ind/m² supported good growth, suggesting that maximum biomass had not been reached.
- ✓ *H. forskali* initially outgrew monocultures, but this trend later reversed, possibly due to limited abalone waste or spatial competition. Fatty acid profile analysis provides strong evidence of trophic interactions.
- ✓ These preliminary results suggest partial functioning of the IMTA system.

Key conclusions

01 Seaweed production

RAS and IMTA achieved up to 24% mean daily biomass gain and showed strong bioremediation potential.

02 Seaweed-based feed

RAS-grown Ulva supported about 3,000 sea urchins, while formulated feeds improved growth and gonad development.

03 Sea cucumber cultivation

Growth depended on sediment, diet and environmental stability, with enriched diets producing the best results.

04 Abalone and sea cucumber co-culture

Co-culture maintained abalone growth, achieved over 75% sea cucumber survival and confirmed trophic transfer.

Together, the pilots validate circular aquaculture as a practical route to reduce waste and diversify sustainable food production.x

Up-scale or/and commercial implementation trials





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VENUE

IPMA, Algés



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S²AQUA
Laboratório Colaborativo
Sustentável para a Aquacultura

AQUAFISH 0.0 Final Meeting · IPMA, Lisbon · 24 September 2026



What are the regulatory and administrative challenges of producing and distributing these products?

Úna Walton, Food Safety Authority of Ireland

On behalf of WestBIC · WP2 Task 1: Regulatory and administrative aspects

The landscape

Common EU framework, national control systems

Country	Coordination body	Typical supervisory route
Ireland	FSAI	SFPA for processing, HSE for retail/catering
Portugal	DGAV	DGAV, with ASAE market surveillance
Spain	AESAN	Regional authorities, RGSEAA where required
France	DGAL	Departmental services (DDPP)

Same EU rules everywhere. Official controls follow the Official Controls Regulation, (EU) 2017/625.

The core rules

Core EU rules and when they apply

General food law

Reg. 178/2002 · safety, traceability, operator responsibility

Hygiene

Reg. 852/2004 for all businesses · Reg. 853/2004 for products of animal origin

Microbiological criteria

Reg. 2073/2005 · criteria for specified foods and microorganisms

Food information

Reg. 1169/2011 · labelling, allergens and, where required, nutrition

Nutrition and health claims

Reg. 1924/2006 · only authorised claims

Novel foods

Reg. (EU) 2015/2283 · if the food or ingredient is novel

Registration, approval and authorisation are different steps

Food business establishments

must register with the competent authority

Many fish processors

need establishment approval before operating, subject to exemptions

Novel foods

and some other regulated products need EU authorisation before marketing

Challenge 1 · Using more of the catch

Food or not food: there is no in-between

Intended for human consumption

Managed under food hygiene rules from the point of generation. It can become an ingredient if all food requirements are met.

Animal by-product

Not intended for human consumption under Reg. 1069/2009. It cannot return to the food chain. Permitted routes depend on its category.

The operator must decide and segregate the intended food stream when it is generated.

Challenge 2 · Novel food

Evidence of significant EU consumption before 15 May 1997

If significant consumption cannot be shown, and the food falls within a novel-food category, EU authorisation is required.

1

Check existing sources

Use the non-binding EU Catalogue as an indicator; check published Article 4 determinations for the precise food

2

Article 4 status decision

If status remains uncertain, consult the authority in the Member State where the food will first be marketed. In Ireland, the FSAI

3

If novel, seek authorisation

EFSA assesses a valid application. The nine-month opinion period can be extended if EFSA requests more information

For producers

Four early checks for producers

1 Identify the supervising authority before fitting out the premises

2 Check novel food status before you scale up

3 Handle material intended as food as food from the start

4 Plan label, claims and composition checks early

Private certification can support compliance, but it does not replace legal registration or approval.



Thank you

Go raibh maith agaibh · Obrigada · Gracias · Merci

Úna Walton, Food Safety Authority of Ireland

WP2.1 report: ctaqua.es/aquafish, Results WP2

AQUA FISH

WWW.AQUAFISHPROJECT.EU

BLUE CIRCULAR INNOVATION EVENT

From Aquaculture to Sustainable Food Solutions

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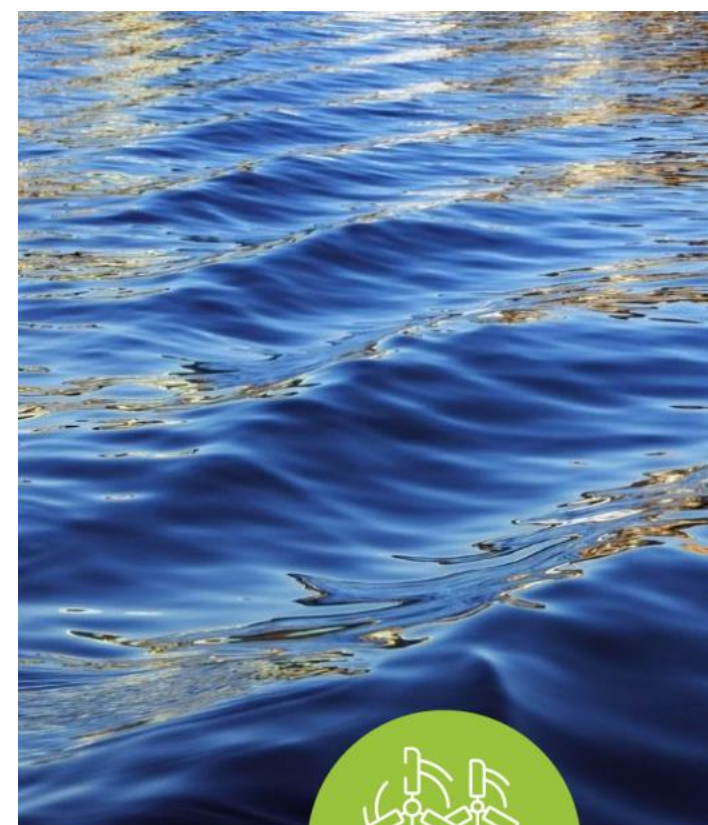
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AQUAFISH

AQUACULTURE & FISHERIES 0.0

Improving the acceptance and social awareness in the consumption of sustainable marine food products developed under the zero-waste philosophy

24 – 09 – 2026
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What are the key food security considerations and risks associated with these products?

Cláudia Afonso



Activity 2.2

Food security and risk assessment

Objectives



This activity aims to carry out a food safety and risk assessment associated with the consumption of new products developed in WP1

Evaluation of dietary recommendations for the effective consumption of the developed products:

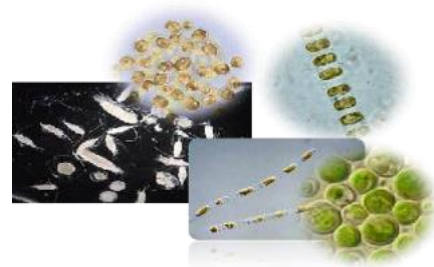
- **Functional products:** Mackerel burger and sausages, seaweed-based nachos and galette, and mackerel-based sauce
- **Seafood-based products:** Tuna pâté (zurrapa), energy bar, and holothurian powder

Seafood: Benefits&Hazardous/Risks

Seafood is recommended in a balanced diet not only for the diversity of species, but also for the important health benefits to consumers

- Proteins of high biological value
- Lipids (EPA+DHA, n-3 PUFA, etc)
- Essential elements (Se, I, etc)
- Vitamins (B1, B12, D, E, etc)
- Carbohydrates
- Biological activities,
- Etc.

- Beneficial effects on cognitive and visual development;
- Lowering the risk of coronary heart disease and stroke;
- Prevention/reduction of multiple other adverse health outcomes



Seafood can also accumulate

toxic compounds - Dioxins, **Lead (Pb)**, **Arsenic (AsT, iAs)**, **Cadmium (Cd)**, **Mercury (HgT, MeHg)**, etc

Mutagenicity, Carcinogenicity, Genotoxicity, etc



Adverse effects upon human health

How to assess the risks and benefits arising from the Seafood consumption?

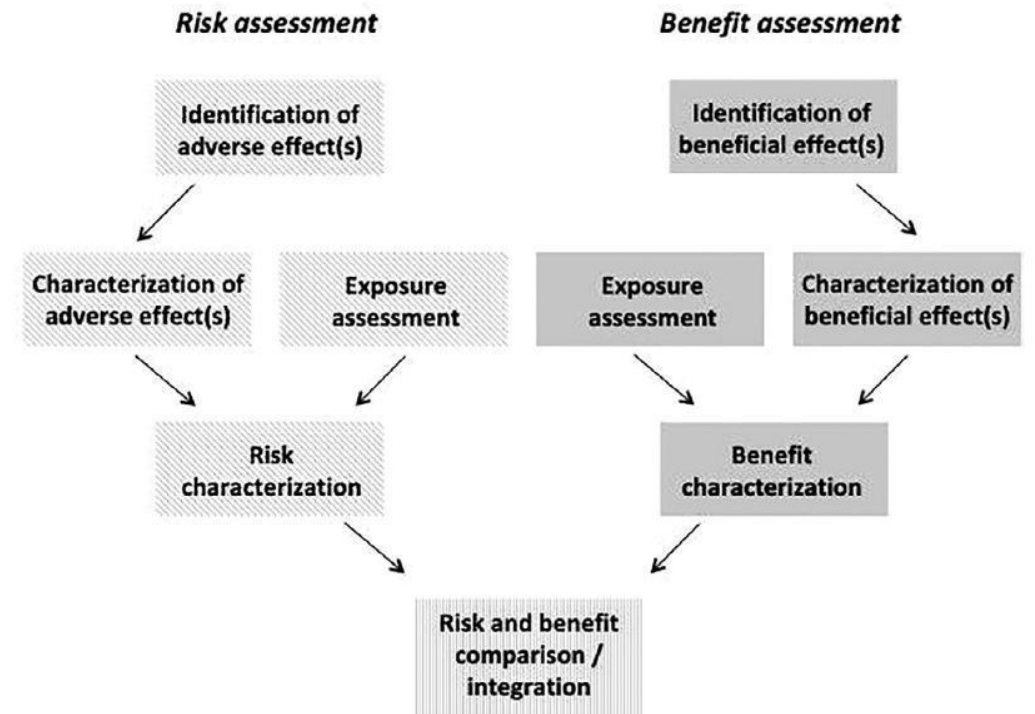
- **Identify main hazards and benefits worthy of study**

Collect nutritional, toxicological & medical data

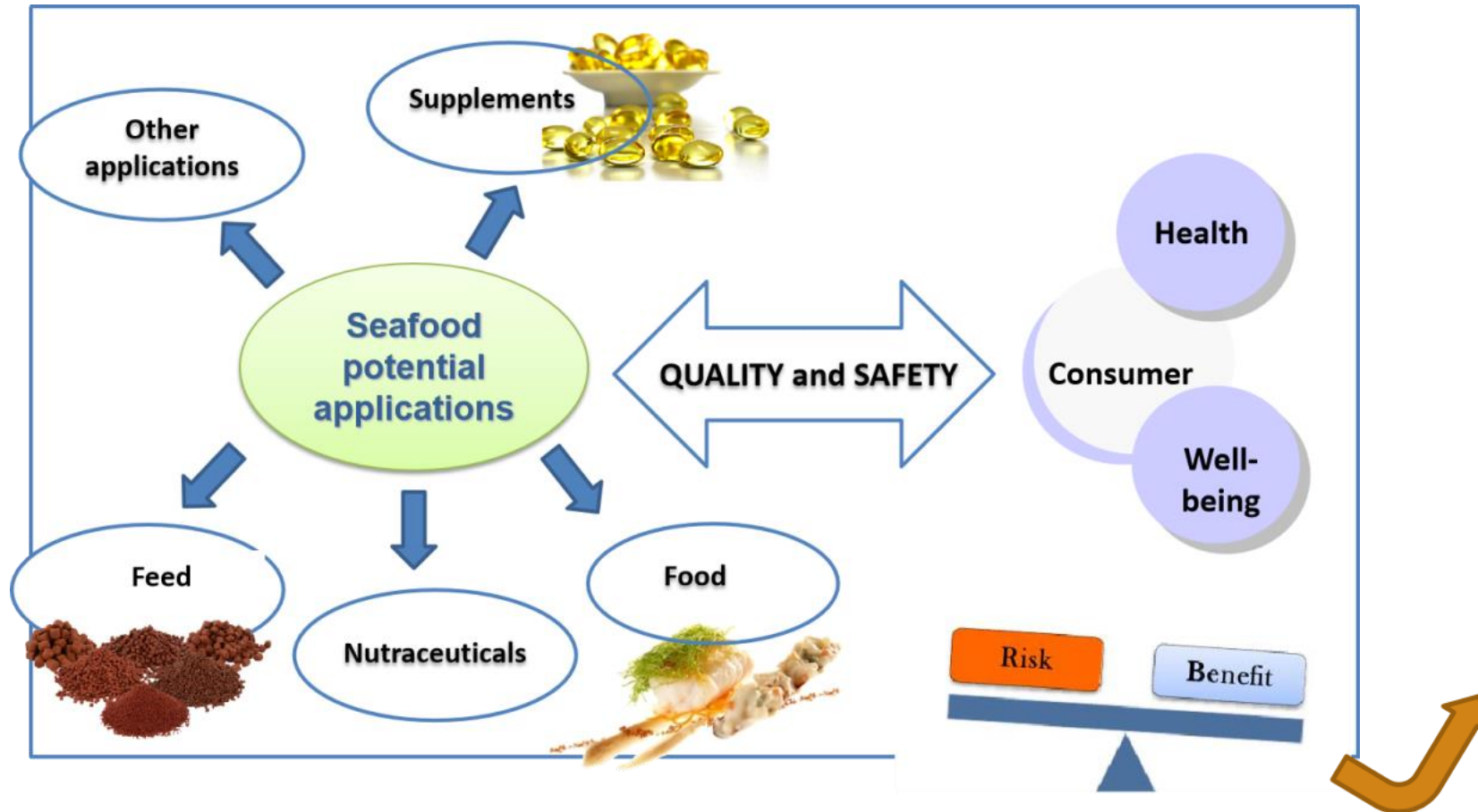
- **Apply a probabilistic approach to quantify probability of exceeding thresholds**

Combine contents with consumption data, consumption frequency, scenarios or surveys)

- **Compare and balance probabilities of exposure to hazards and attainment of benefits**



Seafood functional products are developed having the future of human food in mind



Compounds

lipids, polyphenols, essential elements, contaminants, etc.

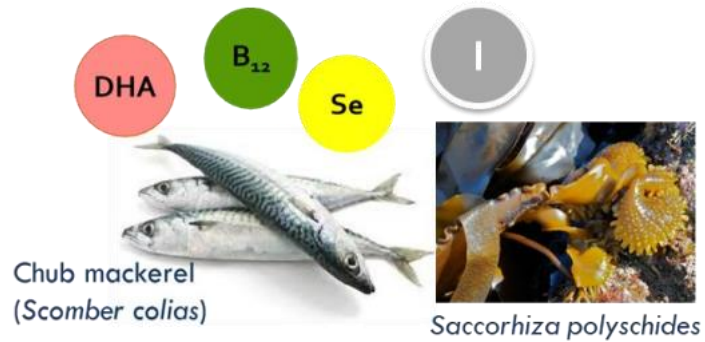
Biological Activities

Anti-inflammatory, antioxidant, cytotoxicity, anti-hypercholesterolemic potential, etc.

Bioaccessibility and bioavailability studies

Case-studies of seaweed-based functional foods

Undervalued and nutritious species

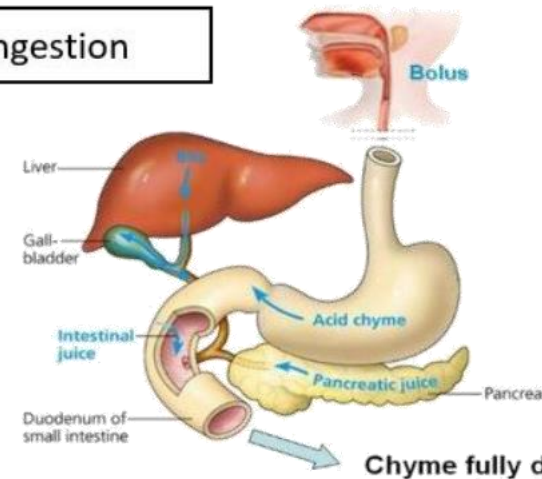


Culinary treatment

- Steamed
- Roasted
- Grilled

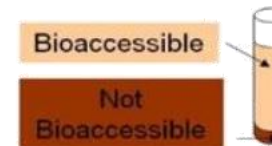
Product rich in neuroprotective nutrients with the potential to prevent and/or delay cognitive decline associated with aging, such as Alzheimer's disease.

Food ingestion



Bioaccessibility of a compound is the amount available for intestinal absorption

Afonso *et al.*, 2015



Case-studies of seaweed-based functional foods

Table 3
Elemental composition (in mg/kg dw) of the harvested in the wild, land-based cultivated, and open sea cultivated *Saccorhiza polyschides* biomass before and after digestion.

Element	Initial vs Bioaccessible	Wild <i>Saccorhiza polyschides</i>	Cultivated <i>Saccorhiza polyschides</i>			
		October	Land-Based February	March	Open Sea July	
As (mg/kg dw)	Initial	17.5 ± 0.3 ^{aA}	15.5 ± 0.6 ^{bA}	14.3 ± 0.2 ^{cA}	15.8 ± 0.1 ^{bA}	
	Bioaccessible	10.4 ± 0.2 ^{aB}	10.7 ± 0.4 ^{aB}	9.5 ± 0.1 ^{bB}	9.4 ± 0.1 ^{bB}	
Se (mg/kg dw)	Initial	1.07 ± 0.05 ^a	1.65 ± 0.14 ^b	1.79 ± 0.10 ^b	1.16 ± 0.00 ^a	
	Bioaccessible	<LOQ	<LOQ	<LOQ	<LOQ	
Cd (mg/kg dw)	Initial	0.60 ± 0.01 ^{bA}	0.07 ± 0.00 ^{dA}	0.26 ± 0.00 ^{cA}	1.11 ± 0.01 ^{aA}	
	Bioaccessible	0.16 ± 0.00 ^{bB}	0.01 ± 0.00 ^{dB}	0.04 ± 0.00 ^{cB}	0.29 ± 0.00 ^{aB}	
I (mg/kg dw)	Initial	522 ± 7 ^{aA}	391 ± 12 ^{bA}	497 ± 24 ^{aA}	367 ± 6 ^{bA}	
	Bioaccessible	260 ± 3 ^{aB}	159 ± 5 ^{cB}	145 ± 7 ^{dB}	183 ± 3 ^{bB}	
Hg (mg/kg dw)	Initial	0.008 ± 0.003 ^a	0.010 ± 0.000 ^a	0.012 ± 0.000 ^a	<LOQ ^b	
	Bioaccessible	<LOQ	<LOQ	<LOQ	<LOQ	
Pb (mg/kg dw)	Initial	0.58 ± 0.01 ^{bA}	1.00 ± 0.01 ^{dA}	0.92 ± 0.06 ^{cA}	0.13 ± 0.00 ^{aA}	
	Bioaccessible	0.017 ± 0.000 ^{aB}	0.013 ± 0.000 ^{bB}	0.007 ± 0.000 ^{cB}	0.001 ± 0.001 ^{dB}	



Farming a wild seaweed and changes to its composition, bioactivity, and bioaccessibility: The *Saccorhiza polyschides* case study

C. Cardoso ^{a,b,*}, J. Almeida ^{a,c}, I. Coelho ^d, I. Delgado ^d, R. Gomes ^a, R. Quintã ^e, N.M. Bandarra ^{a,b}, C. Afonso ^{a,b}

- *S. polyschides* is a good source of I
- Bioaccessibility of Iodine is 30 - 50 %



Saccorhiza polyschides



Table 7 - Risk-benefit assessment through quantification of threshold-exceeding probability (%) for seaweed consumption based on scenarios and taking into account the iodine content.

Seaweed Species	Iodine															Sample Dimension
	1 meal/year			1 meal/month			1 meal/week			2 meals/week			3 meals/week			
	UL (1100 µg/day)	UL (600 µg/day)	AI (150 µg/day)	UL (1100 µg/day)	UL (600 µg/day)	AI (150 µg/day)	UL (1100 µg/day)	UL (600 µg/day)	AI (150 µg/day)	UL (1100 µg/day)	UL (600 µg/day)	AI (150 µg/day)	UL (1100 µg/day)	UL (600 µg/day)	AI (150 µg/day)	
Green Seaweed	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	1.08×10 ⁻⁷	2.91×10 ⁻⁴	7.82×10 ⁻⁵	1.42×10 ⁻³	1.09	2.79×10 ⁻⁴	2.17×10 ⁻²	9.58	2.30×10 ⁻²	0.28	19.11	50
<i>Ulva</i> sp.	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	8.00×10 ⁻³	4.00×10 ⁻⁵	1.19×10 ⁻³	2.64	1.27×10 ⁻⁵	1.69×10 ⁻³	12.15	36
Red Seaweed	2.51×10 ⁻³	6.71×10 ⁻³	6.34×10 ⁻²	<1.0×10 ⁻⁸	0.36	3.17	1.55	3.62	18.34	4.96	9.27	31.64	7.84	14.79	41.43	87
Brown Seaweed	0.09	0.24	2.41	8.44	8.76	30.38	19.8	31.12	63.68	33.77	47.43	77.92	42.62	56.94	84.21	315
<i>Alaria esculenta</i>	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	59.39	<1.0×10 ⁻⁸	18.67	85.72	59.97	83.8	99.75	30
<i>Fucus</i> sp.	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	1.62×10 ⁻⁸	1.32×10 ⁻⁶	3.09×10 ⁻²	5.01×10 ⁻⁴	4.56×10 ⁻²	37.92	6.33×10 ⁻²	9.99	77.25	1.55	19.80	88.33	38
<i>Laminaria</i> sp.	<1.0×10 ⁻⁸	1.03×10 ⁻⁷	3.40×10 ⁻²	8.34	23.82	83.68	68.47	85.34	97.59	86.8	94.1	99.00	92.20	96.27	99.25	69
<i>Saccharina</i> sp.	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	6.23×10 ⁻⁶	6.21×10 ⁻⁴	3.36	81.13	57.58	83.54	97.57	85.56	94.05	98.84	92.12	96.2	99.09	62
<i>Saccharina latissima</i>	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	8.65×10 ⁻⁴	6.37×10 ⁻²	4.62	83.76	59.25	85.26	97.62	87.64	94.62	99.05	93.20	96.86	99.11	51
<i>Undaria</i> sp.	6.76×10 ⁻⁷	3.60×10 ⁻⁶	1.65×10 ⁻⁴	1.67×10 ⁻⁴	1.15×10 ⁻³	9.36×10 ⁻²	1.68×10 ⁻²	0.12	9.89	0.18	1.14	52.76	0.59	3.69	76.14	38
<i>Undaria pinnatifida</i>	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	<1.0×10 ⁻⁸	4.57×10 ⁻⁷	2.32×10 ⁻⁵	4.49×10 ⁻⁶	7.69×10 ⁻⁴	8.63	1.75×10 ⁻³	0.23	41.27	0.06	4.33	62.33	36

Calculated probability of exceeding the iodine UL [$P(X_i > AI \text{ or } UL)$, %]. Considering for iodine the UL of 1100 µg/day (NRC, 2000), 600 µg/day (EFSA, 2006) and the AI of 150 µg/day (EFSA, 2014). Values in bold correspond to probabilities calculated through the 'plug-in' (PI) estimator.

Concerning specific scenarios, they varied from once a year to three times within a week, with the distributions for each component concentration, taking into account a minimal (2.6 g dw) and maximum (9.6 g dw) individual meal portion (IMP)

It is important to know & quantify the risk-benefit balance



Issuance of Dietary Recommendations

Healthy recipes based on sustainable, safe, tasty and nutritious seafood



Table 6 - Selenium and iodine content (expressed in µg/100 g ww or, in the case of seaweed, µg/100g dw) in the initial and bioaccessible samples of the ingredients (chub mackerel, boiled quinoa, and the seaweed *Saccorhiza polyschides*) and hamburgers (raw and cooked) and respective elemental bioaccessibility percentage.

Element		Ingredient			Hamburger			
		Raw chub mackerel	Quinoa (boiled)	Seaweed <i>Saccorhiza polyschides</i> (freeze-dried)*	Raw	Steamed	Roasted	Grilled
Se	Initial (µg/100 g)	59±4 ^A	1.1±0.1 ^A	116±0	48±2 ^{aA}	50±4 ^{aA}	54±3 ^{abA}	61±5 ^{bA}
	Bioacc. (µg/100 g)	47±3 ^B	0.08±0.01 ^B	<LOQ	38±1 ^{aB}	41±3 ^{aB}	46±4 ^{aB}	43±2 ^{aB}
	Bioaccessibility (%)	80±0 ^Y	7±0 ^S	<LOQ	80±10 ^Y	82±13 ^Y	85±5 ^Y	70±0 ^Y
I	Initial (µg/100 g)	25±1 ^A	<LOQ	36720±603 ^A	224±7 ^{aA}	221±2 ^{aA}	232±16 ^{abA}	255±6 ^{abA}
	Bioacc. (µg/100 g)	19±1 ^B	ND	17586±289 ^B	127±4 ^{aB}	153±1 ^{ab}	163±11 ^{ab}	153±4 ^{ab}
	Bioaccessibility (%)	78±0 ^Y	ND	48±3 ^E	57±1 ^Z	69±2 ^S	70±1 ^S	60±2 ^Z

Hamburger enriched in *S. polyschides*



I Bioaccessible

153 µg/100g (102 % DRV)

Nutritional information			
Steamed Hamburger			
Dose/100 g			
			% DRV
Calories	kcal	140	
Fat	kcal	51	
Protein	kcal	73	
Fat	g	5,65	
DHA	mg	1234	494
Protein	g	18.3	40**
** Considering AR of 0.66 g per body weight (EFSA) and a 70 kg adult			
Essential elements			
Selenium	µg	50	71-91*
Iodine	µg	221	147*

DRV- Dietary Reference Value *EFSA-IOM

Case-studies of seaweed-based functional foods

The composition and properties of this functional food were thoroughly study as well as their stability over storage time



Article

Mackerel and Seaweed Burger as a Functional Product for Brain and Cognitive Aging Prevention

Carlos Cardoso ^{1,2,*}, Jorge Valentim ^{2,3}, Romina Gomes ^{2,4}, Joana Matos ², Andreia Rego ⁵, Inês Coelho ⁵, Inês Delgado ⁵, Carla Motta ⁵, Isabel Castanheira ⁵, José A. M. Prates ^{6,7}, Narcisa M. Bandarra ^{1,2} and Cláudia Afonso ^{1,2}

Heliyon 10 (2024) e27171



Research article

Influence of cooking methods and storage time on colour, texture, and fatty acid profile of a novel fish burger for the prevention of cognitive decline

Jorge Valentim ^{a,b}, Cláudia Afonso ^{b,c}, Romina Gomes ^{b,d}, Ana Gomes-Bispo ^{b,c}, José A.M. Prates ^{e,f}, Narcisa M. Bandarra ^{b,c}, Carlos Cardoso ^{b,c,*}

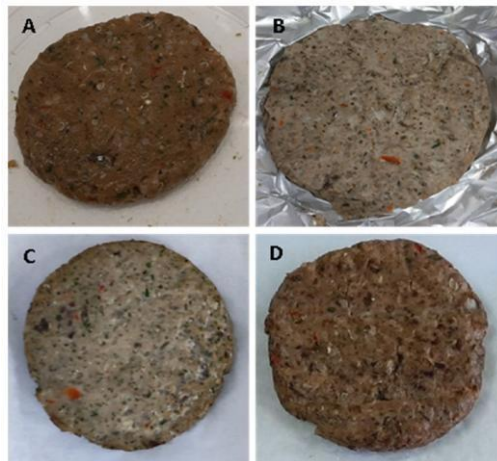


Fig. 1. The prepared fish hamburgers (A: raw; B: steamed; C: roasted; and D: grilled).

Organoleptic study ✓

Color.
Odor.
Texture.
Other physical properties.
Presence/Absence of mold.

Food safety/risk assessment: Microbiological → Raw materials selected from WP1.

Microbiological validation

- *Count of aerobic microorganisms.*
- *Count of Enterobacteriaceae.*
- *Presence/Absence of Escherichia coli.*
- *Presence/Absence of Salmonella spp.*
- *Presence/Absence of Listeria monocytogenes*

Objective:

Ensure the food safety and hygiene of the raw material acquisition processes

Case-studies: Tuna pate (zurrapa)

Organoleptic study



Microbiological validation raw material:

Parameter	Result (cfu/g)	Unit	Limits
<i>Salmonella</i> spp	Not detected	-	-
<i>Listeria monocytogenes</i>	Not detected	-	Not detected
<i>Escherichia coli</i>	Not detected	-	-
Enterobacteria	<1.00E+01	cfu/g	-
Aerobes	<1.00E+02	cfu/g	-

Table 1. Microbiological validation of fish cooking water.

Parameter	Value	Unit
Energy value	746	KJ/100g
	176	Kcal/100g
Crude protein	43.00	g/100g
Fats	<1.00	g/100g
Saturated fats	0.06	g/100g
Carbohydrates	<2.00	g/100g
Total sugars	<1.00	g/100g
Salt	5.90	g/100g

Table 3. Nutritional composition of tuna mojama trimmings.

Parameter	Value	Unit
Energy value	17	KJ/100g
	4	Kcal/100g
Moisture	93.5	g/100g
Crude protein	1.0	g/100g
Fats	<0.5	g/100g
Carbohydrates	<0.5	g/100g
Total sugars	<0.5	g/100g
Total fiber	<1.0	g/100g
Ash	5.5	g/100g
Salt	5.8	g/100g
Sodium	2.3	g/100g
pH	6.1	pH units

Table 2. Nutritional composition of fish cooking water.

Microbiological validation product: awaiting microbiological

results from storage over an extended period of time

TUNAPÂTÉ		
Ingredients	Quantity (g)	Quantity (%)
Fish cooking water	218	19.6
Mineral water	382	34.4
Soylecithin	60	5.4
Almond flour	120	10.8
Sodium alginate	30	2.7
Tuna mojama trimmings	300	27.0
TOTAL	1110	100.0

Table 4. Formulation of tuna pâté.

Parameter	Result (cfu/g)	Unit	Limits
<i>Clostridium botulinum</i>	Not detected	-	Not detected
<i>Salmonella</i> spp	Not detected	-	Not detected
<i>Listeria monocytogenes</i>	Not detected	-	Not detected
<i>Escherichia coli</i>	Not detected	-	Not detected
Enterobacteriae	<1.00E+01	cfu/g	-
Aerobes	1.40E+04	cfu/g	-

Table 5. Microbiological validation of tuna pâté.

Parameter	Value	Unit
Energy value	968	KJ/100g
	232	Kcal/100g
Moisture	55.70	g/100g
Crude protein	10.30	g/100g
Fats	14.00	g/100g
Carbohydrates	15.70	g/100g
Total sugars	1.10	g/100g
Total fiber	1.00	g/100g
Ash	3.30	g/100g
Salt	1.76	g/100g
Sodium	0.70	g/100g

Table 6. Nutritional composition of tuna pâté.

Parameter	Value	Unit
Saturated fatty acids	2.20	g/100g
Butyric acid (C:4:0)	<0.1	%
Caproic acid (C:6:0)	<0.1	%
Caprylic acid (C:8:0)	<0.1	%
Capric acid (C:10:0)	<0.1	%
Undecanoic acid (C:11:0)	<0.1	%
Lauric acid (C:12:0)	<0.1	%
Tridecanoic acid (C:13:0)	<0.1	%
Myristic acid (C:14:0)	0.2	%
Pentadecanoic acid (C:15:0)	0.1	%
Palmitic acid (C:16:0)	12.1	%
Margaric acid (C:17:0)	0.1	%
Stearic acid (C:18:0)	2.7	%
Arachidic acid (C:20:0)	0.2	%
Heneicosanoic acid (C:21:0)	<0.1	%
Behenic acid (C:22:0)	0.2	%
Tricosanoic acid (C:23:0)	0.1	%
Lignoceric acid (C:24:0)	0.1	%
Monounsaturated fatty acids	8.22	g/100g
Myristoleic acid (C:14:1)	<0.1	%
Pentadecenoic acid (C:15:1)	<0.1	%
Palmitic acid with isomer (C:16:1)	0.9	%
Margaroleic acid (C:17:1)	0.1	%
Oleic acid with isomer (C:18:1)	57.1	%
Gondoic acid (C:20:1)	0.2	%
Erucic acid (C:22:1n9)	0.1	%
Nervonic acid (C:24:1n9)	0.2	%
Polyunsaturated fatty acids	3.58	g/100g
Linoleic acid with isomer (C:18:2)	23.2	%
Linolenic acid with isomer (C:18:3)	1.1	%
Linolenic acid (C:18:3n3)	1.1	%
Gamma-linolenic acid (C:18:3n6)	<0.1	%
Stearidonic acid (C:18:4n3)	0.1	%
Eicosadienoic acid (C:20:2n6)	<0.1	%
Dihomo-gamma-linolenic acid (C:20:3n6)	<0.1	%
Arachidonic acid (C:20:4n6)	0.1	%
Eicosatrienoic acid (C:20:3n3)	<0.1	%
Eicosatetraenoic acid (C:20:4n3)	<0.1	%
Eicosapentaenoic acid (EPA) (C:20:5n3)	0.2	%
Docosadienoic acid (C:22:2n6)	<0.1	%
Docosapentaenoic acid (DPA) (C:22:5n3)	0.1	%
Cervonic acid (DHA) (C:22:6n3)	0.9	%

Table 7. Fatty acids profile of tuna pâté.

Case-studies: Fish seasoning

ctaqua

CENTRO TECNOLÓGICO
DE LA ACUICULTURA

Organoleptic study

Microbiological validation raw material:

Parameter	Result	Unit	Limits
<i>Salmonella</i> spp	Not detected	-	Not detected
<i>Listeria monocytogenes</i>	Not detected	-	Not detected
<i>Escherichia coli</i>	Not detected	-	-
Enterobacteria	<1.00E+01 ± 0.00E+00	cfu/g	1.00E+03
Aerobes	1.07E+03 ± 5.77E+01	cfu/g	1.00E+06

Table 2. Microbiological validation of fresh anchovy.

Parameter	Value	Unit
Moisture	76.0 ± 0.7	g/100g
Crude protein	20.7 ± 0.8	g/100g

Table 3. Nutritional composition of fresh anchovy.

Ingredients	Quantity (g)	Quantity (%)
Fresh anchovy	15000	100.00
TOTAL	15000	100.00

Table 4. Formulation of anchovy seasoning.

Microbiological validation product: awaiting microbiological results from storage over an extended period of time

Parameter	Result	Unit	Limits	Where
Histamines	21.9 ± 4.1	mg/kg	Mean ≤ m Maximum of c/n values between m and M No values higher than M	m=100 mg/kg n=9; c=2 M=200 mg/kg
<i>Salmonella</i> spp	Not detected	-	Not detected	-
<i>Listeria monocytogenes</i>	Not detected	-	Not detected	-
<i>Escherichia coli</i>	Not detected	-	Not detected	-
Enterobacteria	<1.00E+01 ± 0.00E+00	cfu/g	1.00E+02	-
Aerobes	1.13E+03 ± 1.15E+02	cfu/g	1.00E+05	-
Total volatile basic nitrogen	95 ± 6	mg/100g	200	-

Table 5. Microbiological validation of anchovy seasoning.

Parameter	Value	Unit
Energetic value	1680 ± 17 398 ± 4	KJ/100g Kcal/100g
Moisture	1.13 ± 0.12	g/100g
Crude protein	76.03 ± 0.65	g/100g
Total fats	10.43 ± 0.15	g/100g
Saturated fatty acids	3.35 ± 0.02	g/100g
Monounsaturated fatty acids	2.24 ± 0.02	g/100g
Polyunsaturated fatty acids	4.85 ± 0.16	g/100g
Carbohydrates	<0.5 ± 0.0	g/100g
Total sugars	<0.5 ± 0.0	g/100g
Ash	11.43 ± 0.68	g/100g
Salt	0.939 ± 0.021	g/100g
Sodium	0.376 ± 0.009	g/100g
pH	5.80 ± 0.10	pH units
Phosphorus	25100 ± 1552	mg/kg
Calcium	9941 ± 1368	mg/kg

Table 6. Nutritional composition of anchovy seasoning.

Parameter	Value	Unit
Aspartic acid	5.4 ± 0.6	%
Glutamic acid	6.9 ± 0.9	%
Serine	3.0 ± 0.3	%
Histidine	3.2 ± 0.3	%
Glycine	3.4 ± 0.2	%
Threonine	1.7 ± 0.4	%
Arginine	3.1 ± 0.3	%
Alanine	4.6 ± 0.4	%
Tyrosine	1.9 ± 0.3	%
Cystine	<0.02 ± 0.0	%
Valine	1.3 ± 0.4	%
Methionine	2.8 ± 0.3	%
Phenylalanine	2.2 ± 0.4	%
Isoleucine	1.2 ± 0.5	%
Leucine	4.7 ± 0.8	%
Lysine	5.9 ± 1.0	%
Proline	<0.02 ± 0.0	%
Tryptophan	1.1 ± 0.3	%
Hydroxyproline	<0.02 ± 0.0	%

Table 7. Amino acids profile of anchovy seasoning.

Key message:

Culinary treatment + bioaccessibility → essential for **risk–benefit assessment** Improves evaluation of seafood nutritional value



Supports recommendations on cooking practices and dietary choices

Outcome:

Promotion of human health and well-being

Microbiology/Chemistry/Organoleptic study:

Safe, stable, and suitable for consumption





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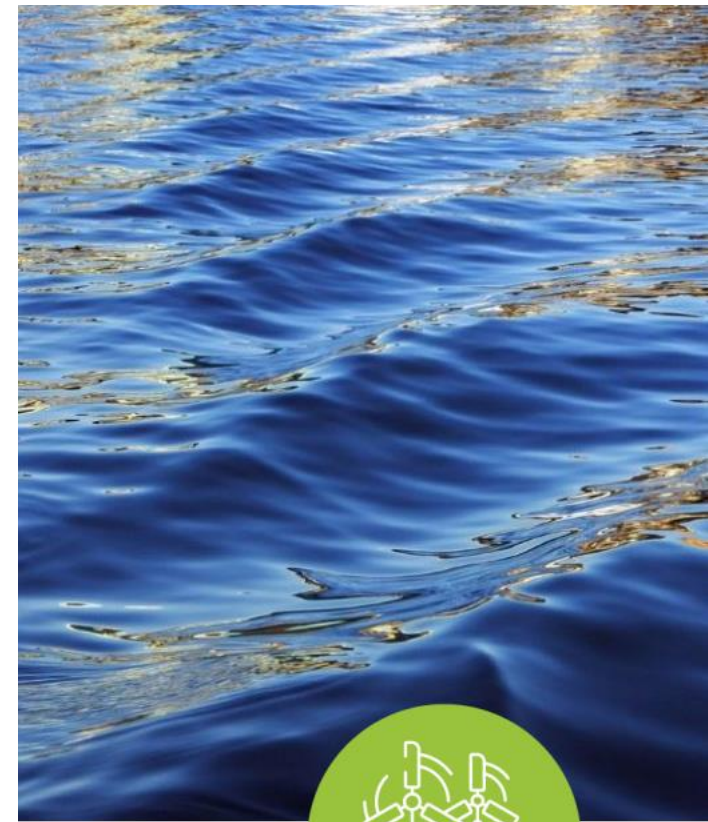
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Workpage 2 Activity 3

Economic and marketing analysis



Technopole Quimper Cornouaille

Methodology



FIRST PART at country level

- Identify the economic dynamics, drivers, levers and brakes for the four country across an economic SWOT
- Analyse market trends in marine by-product recovery across three segments for the four country

SECOND PART at Company-level

- Elaborate and model marine by-product valorisation scenarios by segment for the company, highlighting the impacts, advantages and disadvantages.
- Produce a tool to support companies that wants to explore a valorisation way of marine products in their decision-making process.
=> Results comes from the analyse of 14 BP from industrial companies in the marine sector in Europe, the majority of which are in France and Ireland, showing 14 different situations in terms of size, flows, seasonality and outlets.

90% of manufacturers outsource their operations to service providers for products such as flour and animal feed, at a purchase price of **€100–€200 per ton.**



What you think it costs.



Material Flow Cost Accounting (MFCA)

Full cost
=
€2,000–9,000/ton



What it costs you = x10 to x50



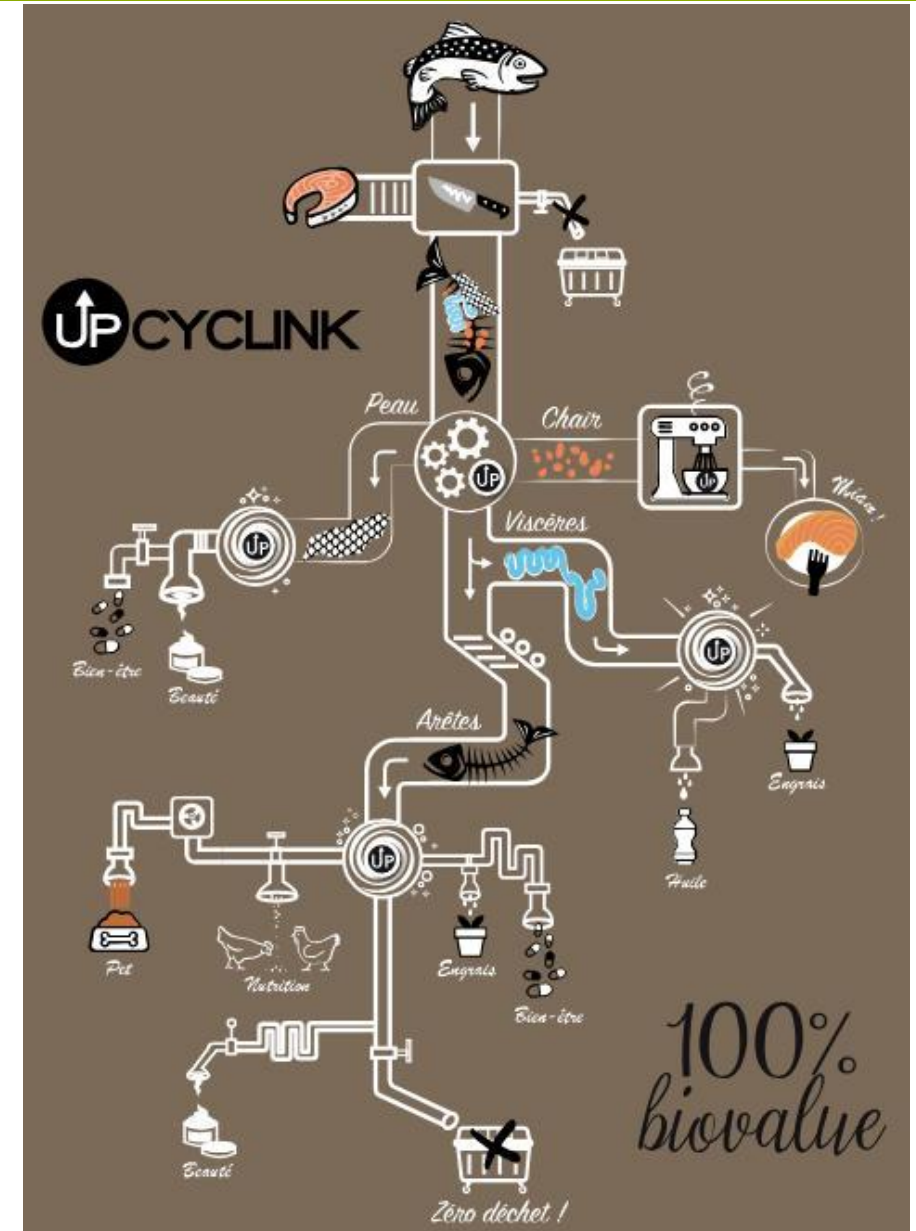
Your by-products **destroy** value ... but could **create it**

Transform your by-products into opportunities

1 biomass
=
Several trajectories
=
Several possible market segments

Problem

by-products are unstable (perishable and seasonal) and require rapid processing or appropriate storage conditions for optimal utilisation.



14 business plans = 3 different approaches

A Phased entry

- ✓ Limited volumes (200–500 ton per year on a regular basis).
- ✓ Food-grade outlet identified
- ✓ CAPEX <1M€
- ✓ Existing “cold” infrastructure
- ✓ ROI is quick if the flow and outlets are secure.

B Integrated model

- ✓ Secure flows (800–1,200 ton per year).
- ✓ Controlled transformation
- ✓ Identified outlets (food, ingredients, feed).
- ✓ Capacity to arbitrate according to price and availability
- ✓ CAPEX: 2-3m€ - structured financing

C Ingredient specialisation

- ✓ Variable volumes – heterogeneous biomass accepted.
- ✓ B2B logic
- ✓ Modular processes – start-up by brick
- ✓ Market access in progress.
- ✓ CAPEX varies according to the module.

	A	B
1	01_INPUT — SAISIE UTILISATEUR	
2		
5	<u>Total by-products (t/year) — heads + bones/flesh</u>	1500
6	<u>Heads (t/an)</u>	0
7	<u>Bones/flesh excluding heads (t/year)</u>	1050
8	<u>% heads (if known, otherwise default = 30)</u>	30
16		
17	<u>Fish pulp</u>	Oui
18	<u>Proportion of flesh converted to pulp (%)</u>	50
19	<u>Heads are separated upstream ?</u>	Non
20		
21	<u>Prepared meals</u>	Non
22	<u>Direct sales to customers ?</u>	Non
23	<u>Do you have Food certifications ?</u>	Oui
24	<u>Do you have culinary expertise ?</u>	Oui
25	<u>Do you have cold storage (freezing) ?</u>	Oui
26		
27	<u>Prioritary products ?</u>	Mix
28		
34	<u>Market horizon (Local/National/Export)</u>	Local
35		
36	<u>Is industrial cold storage available ?</u>	Oui
37	<u>Is heat/steam available ?</u>	Oui
38	<u>Is there an existing compliant building ?</u>	Non
39		
40	<u>Product strategy (single or multiple) ?</u>	Simple
41		

	A	B
1	02_RESULTS — VERDICT CALCULATED	
2		
3	VALID INPUT?	✓
4		
5	INVESTMENT	
6	<u>CAPEX MIN</u>	1 043 900,00 €
7	<u>CAPEX MAX</u>	1 435 500,00 €
8		
9	ACCOUNT	
10	<u>CA total (€/an)</u>	916 500,00 €
11	<u>OPEX process (€/an)</u>	435 810,00 €
12	<u>OPEX total (€/an)</u>	470 674,80 €
13	<u>EBITDA (€/an)</u>	445 825,20 €
14		
15	PROFITABILITY	
16	<u>Payback MIN (ans)</u>	2,3
17	<u>Payback MAX (ans)</u>	3,2
18	<u>ROI 7 ans MIN (%)</u>	42,7
19	<u>ROI 7 ans MAX (%)</u>	31,1
20		
21	<u>VERDICT</u>	GO
22		
26		
27		
28		
29		
30		

	A	B
1	01_INPUT — SAISIE UTILISATEUR	
2		
5	<u>Total by-products (t/year) — heads + bones/flesh</u>	100
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41		

	A	B
1	02_RESULTS — VERDICT CALCULATED	
2		
3	VALID INPUT?	✓
4		
5	INVESTMENT	
6	<u>CAPEX MIN</u>	1 043 900,00 €
7	<u>CAPEX MAX</u>	1 435 500,00 €
8		
9	ACCOUNT	
10	<u>CA total (€/an)</u>	61 100,00 €
11	<u>OPEX process (€/an)</u>	138 996,00 €
12	<u>OPEX total (€/an)</u>	150 115,68 €
13	<u>EBITDA (€/an)</u>	-89 015,68 €
14		
15	PROFITABILITY	
16	<u>Payback MIN (ans)</u>	n/a
17	<u>Payback MAX (ans)</u>	n/a
18	<u>ROI 7 ans MIN (%)</u>	n/a
19	<u>ROI 7 ans MAX (%)</u>	n/a
20		
21	<u>VERDICT</u>	NO-GO
22		
26		
27		
28		
29		
30		

Conclusion



The by-products **destroy** value, but they could also **create it**.



1 biomass = **Several trajectories** = **Several possible market segments**



Turn by-products into **opportunities** by identifying the most suitable scenario for company.



Before you start, it is essential to: have a **stable income/ find your market / not underestimate the CAPEX**



A **tool** will be **available** to help company assess the potential value of their marine by-products.

Thank you

Gracias

Merci

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Obrigada



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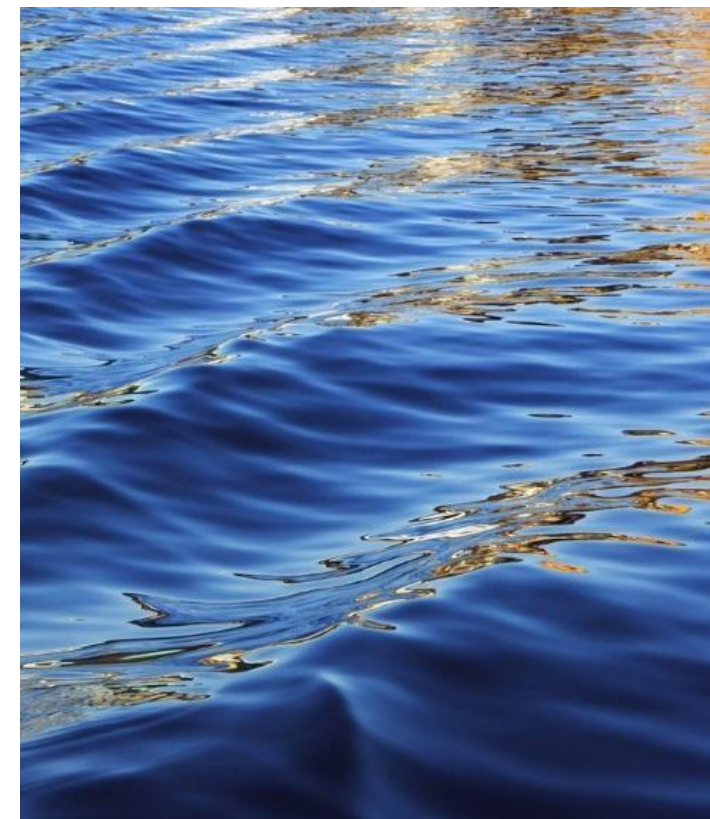
06 02 00 58 66



Sarah GERART

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07 86 25 84 87



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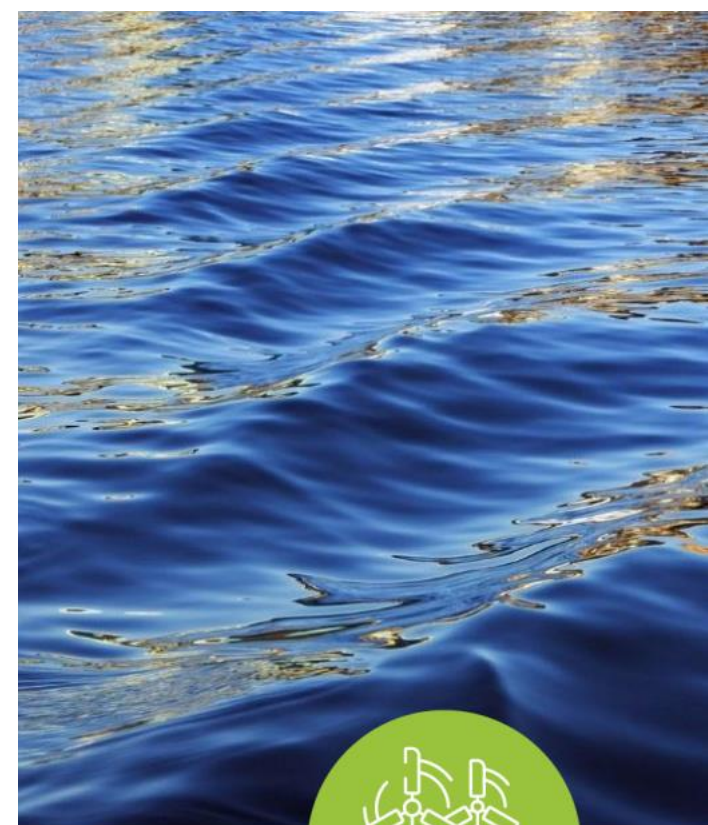
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Global Marketing Strategy

Thoby Sylvie – Institut Agro



Activity #activity

WP 2

ad Environmental
administrative feasibility

Ta

sk3. Making economic analyses

Objectives : Marketing positioning of marine coproducts

Essential for unlocking their potential, transforming what is often perceived as waste into high-value resources that meet growing demands for sustainability, innovation, and responsible consumption.

✦
**High-value
marine resources**

The Value of Byproducts : These are no longer considered “waste,” but rather **valuable marine resources** rich in nutrients and offering culinary and technological potential.

♻️
Circular economy

The circular economy : The industry is committed to a **zero-waste approach**, in which every part of the fish is used, thereby reducing pressure on key species and preserving biodiversity.

♥️
Health innovation

Health innovation : The products developed highlight their **nutritional benefits** (protein, omega-3, calcium, bioactive peptides), while meeting the expectations of consumers committed to a healthy and responsible diet.

⚓
Origin "France"

Country of origin

Key differentiating factors

3 keys of differentiation can be worked on individually or combined.

The anti-waste argument: An educational campaign promoting the use of whole fish, featuring ‘anti-waste’, ‘circular’ and ‘sustainable’ labels.

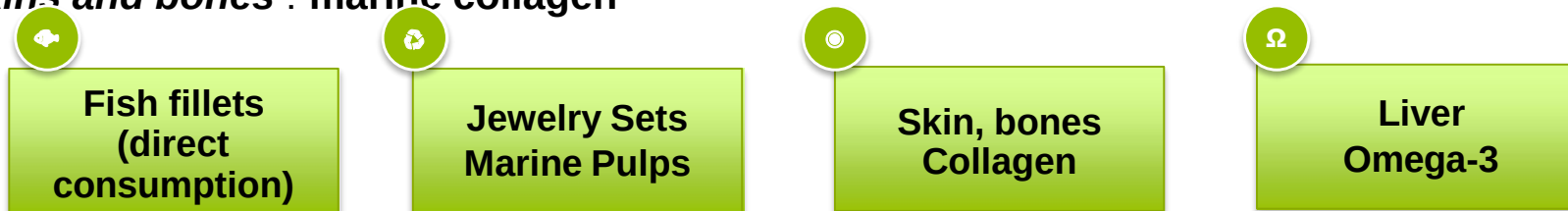
Health benefits:

Bones & cartilage : calcium and **bioactive peptides** ingredients

Fillet trimmings : a **source of protein** and **low in fat** for white fish, thus allowing for protein enrichment of processed products without added fat and with **good digestibility**.

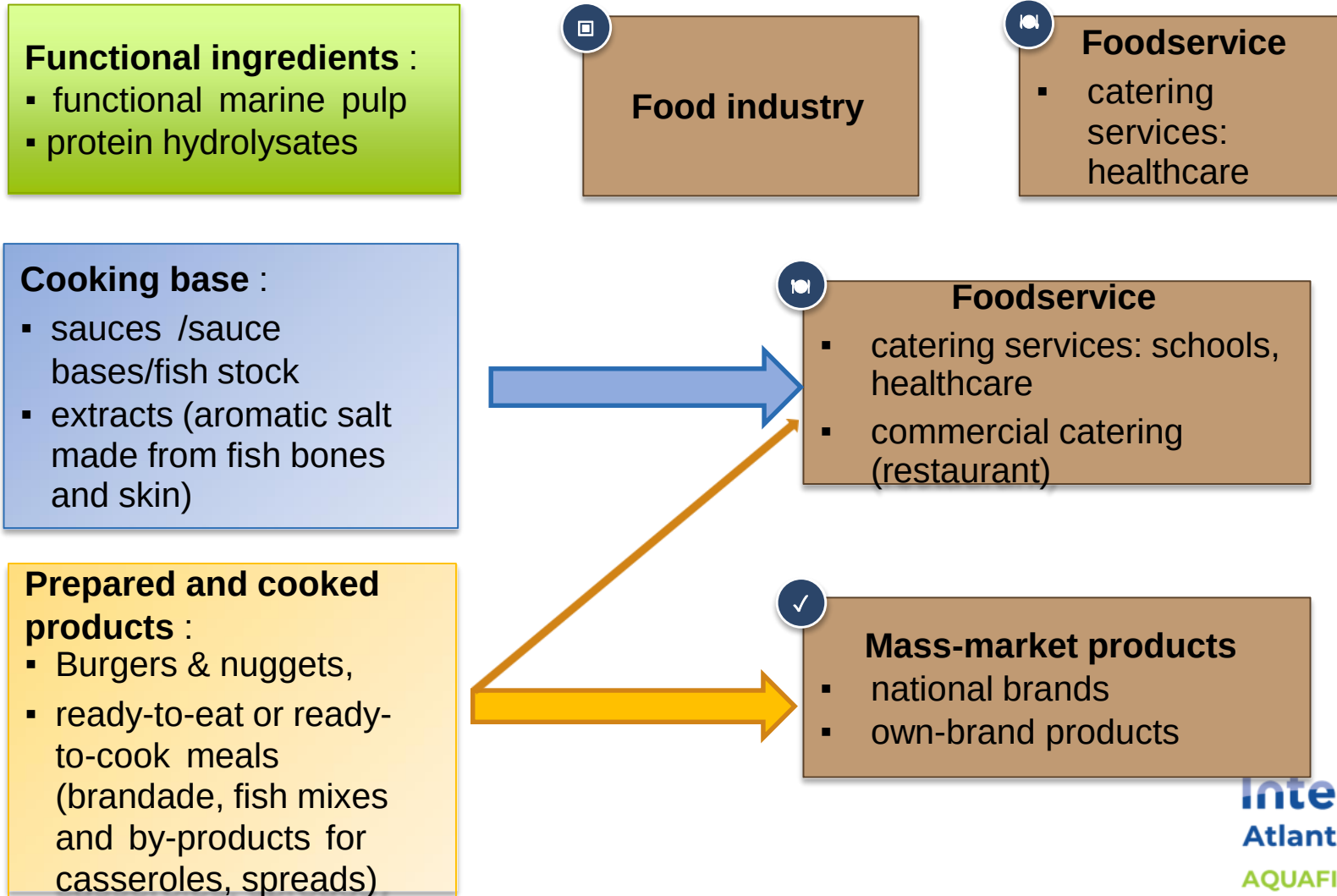
Liver : a source of **omega-3**, helping to prevent cardiovascular diseases

Skins and bones : **marine collagen**



CSR commitment : Partnerships with local fishmongers and fishermen, raising awareness of marine conservation, and compliance with regulations (the Egalim Act, sustainable fishing quotas)

Product and market applications



Price

The idea is to adopt **a strategy based on functional value** rather than a low-cost positioning; hence a three-tiered pricing approach based on the product developed and its intrinsic attributes, in particular

	Range	Positioning	Rationale
•	Entry	Competitive vs fillet	Raw material cost optimization
•	Mid-range	Functional standard	Nutrition (Protein) + CSR
•	Premium	Enriched (collagen)	Innovation + added value

The key argument is the **competitive protein content per kg**, ant to justify the price through the product's **functionality** and **sustainability positionning** to avoid a “low-cost waste” image.

Communication plan

Educational storytelling :

- Campaigns explaining the zero-waste approach (circular economy)
- Environmental and social benefits (preserving biodiversity, reducing pressure on species, supporting local fishermen and fishmongers).
- Value creation: making full use of the catch and the species, lower prices than flagship species
- Health & nutrition argument: “Health benefits from the sea, 100% utilised”

Impact : Collaboration with chefs and experts to promote the use of by-products in cooking.

Press and trade fair relations : promoting innovation and sustainability

Collective branding: Creation of an umbrella brand (e.g. ‘Valorisé en France – Circular Marine Resources’) to bring stakeholders together and boost the visibility of products.

**Engaging
stakeholders in the
sector**

**Educating buyers
and consumers**

**Compatibility with
the circular economy
and the Egalim Act**

**Full economic use of
the resource**

To sum up



Threats

Negative image of
« waste »

Consumer
acceptability

Volumes

Price



Solutions

Replace the term 'by-product', which has negative connotations, with a more positive term

- Valued marine resources
 - Premium marine ingredients
 - A new lease of life for marine resources
- It is not a by-product, but a highly useful co-product!*

Develop an educational strategy

- Whole-fish storytelling
- zero waste Label: anti-waste, sustainable, circular
- Highlighting the health benefits

Establish collective branding

Create an umbrella brand?
'Valued in France – Circular Marine Resources'
A collective brand?

Perhaps move away from the low-cost image associated with the by-product and instead focus on the functional value of the products developed. Depending on the products, there could be:

- Entry-level pricing
- Mid-range pricing
- Premium pricing

Example : Marin Pulp

FRONT



BACK



Storytelling

Sustainability image and logo

Nutritional benefits

Culinary Application

Origin and tracability

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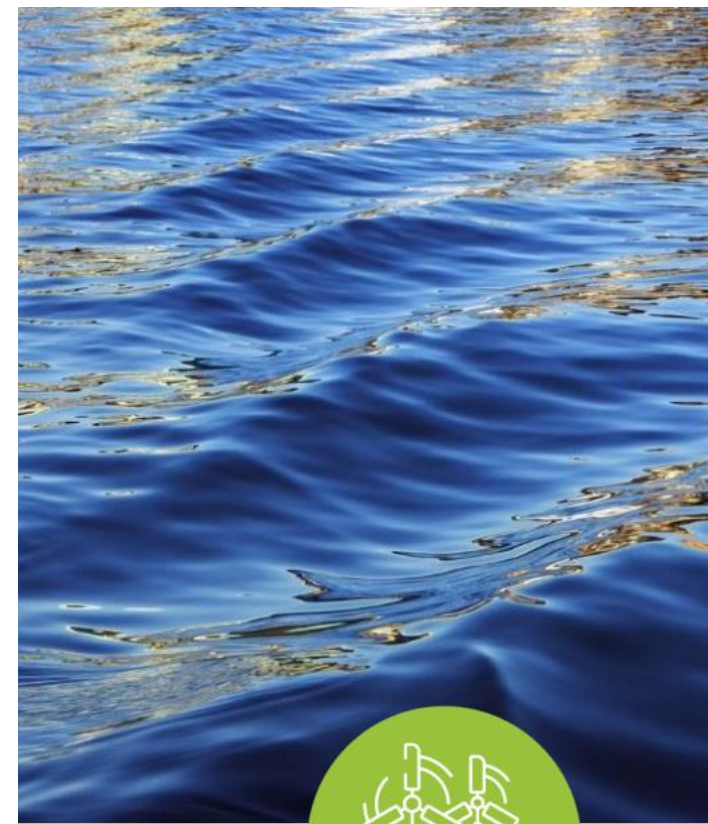
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CEEI BAHÍA DE CÁDIZ



How does the new generation engage with novel foods?

**Carolina Salguero – CEEI Bahía de Cádiz
(European Business and Innovation Centre, Spain)**



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Activity 3

Social acceptance of Sustainable
aquaculture and fisheries

AQUAFISH0.0 EXPERIENTIAL CLASSROOM

MOBILE LEARNING CLASSROOM

A unique experience through immersive technology, gamified and dynamic learning.

Aimed at:

Pupils aged 6 to 12. Age-appropriate activities with a practical, participatory and fun approach.



IMMERSIVE TECHNOLOGY IN THE CLASSROOM



GAMIFIED AND VISUAL LEARNING



PRACTICAL AND PARTICIPATORY WORKSHOPS

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Activity 3

Social acceptance of Sustainable
aquaculture and fisheries

Reach of the experience

14

Educational sessions

≈500

Schoolchildren reached

9

Schools



13 Remote Classroom sessions, plus one “Circular Sea” event

Activities took place from 18th May to 5th June 2026 across five municipalities in the province of Cádiz.

Activity 3

Social acceptance of Sustainable
aquaculture and fisheries



Activity 3

Social acceptance of Sustainable
aquaculture and fisheries

From curiosity to acceptance

1. See

An image or experience sparks interest.

2. Understand

An explanation makes the unfamiliar feel less strange.

3. Try

Interaction helps students form their own opinion.

4. Share

Sharing the experience reinforces learning.



Activity 3

Social acceptance of Sustainable
aquaculture and fisheries

How to engage the new generation

Make it visible

Short videos, images and immersive experiences.

Make it clear

Explain where it comes from, how it is produced and why it matters.

Make it participatory

Challenges, recipes, games and meaningful choices.

Make it relevant

Local products and examples from everyday life.

Provide continuity

Connect the classroom with homes, kitchens and the community.

The new generation engages when they can explore before they choose

The Remote Classroom turned marine sustainability into an accessible,
participatory and relevant experience.





More information: [Proyecto AQUAFISH0.0 - Ceei Bahía de Cádiz.](#)

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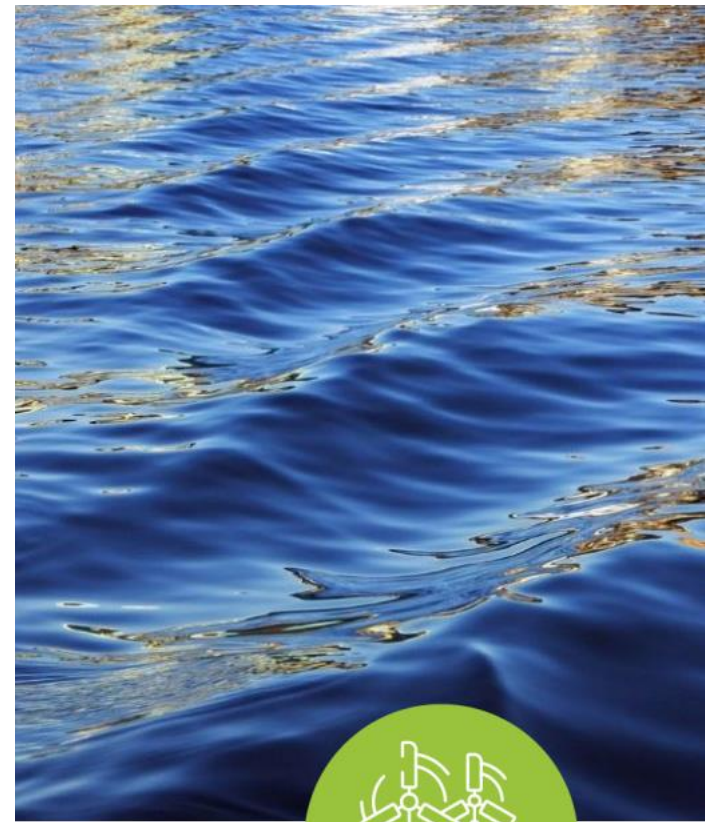
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Are consumers willing to try new products?

Sterenn LUCAS
L'Institut Agro

Objectives

- Assess European consumers' acceptance of marine by-products, undersized species and undervalued species
- Focus on seaweed and sea cucumbers

Methodology

Two complementary approaches:

- **Qualitative interviews** – 8 semi-structured interviews to help calibrate the survey
- **Quantitative Survey** – online - 4,000 respondents (1,000 per country)



Products proposed

Marine by-products

Fish skin crisps

Sauce from fish bone powder

Pudding made from fish tripe

Spreadable made from leftover fish flesh

Sauce made from crustacean shells

Undervalued species or sizes

Small-sized fish

Unfamiliar fish

New species

Seaweed

Sea cucumber

Results – marine by-products

- **Most popular: sauce made from crustacean shells (64%)**
- **Least accepted: pudding made from fish tripe (39%)**
- **Most mature market: Spanish consumers**
- **Most reluctant market: Irish consumers**
- **Higher acceptance :**
 - 👤 men
 - 🐟 regular consumers of aquatic products (at home and out of home)
 - 🌍 people with high environmental awareness
 - 💡 people with good knowledge of the sector

Results – unfamiliar species and small-sized fish

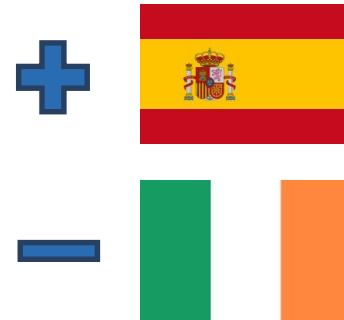
	Unfamiliar species	Small-sized fish
Acceptance levels	Moderately positive and similar	
	62 %	65 %
Most mature markets	 	 
Higher acceptance	Men	35 years and over
	Regular consumers of aquatic products:	
	At home and out of home	At home
	People with high environmental awareness	
	People with good knowledge of the sector	

Results – sea cucumbers

- Fewer than 50% of respondents are willing to taste a sea cucumber based on a simple picture
- This rate rises to 56% after a description of the taste and texture
- The consumption context (shared with family, product freshness) increases acceptance
- Women and young people are the most reluctant
- Regular consumers of aquatic products have a higher level of acceptance
- Pro-environmental behaviours and knowledge of the sector are also positively correlated with acceptance



Acceptance level



Results – seaweed

- 70% of respondents are willing to taste seaweed based on a simple picture
- No change after a description of the taste and texture – good knowledge of the product
- The consumption context (shared with family or friends) increases acceptance (75%)
- Young people are the most reluctant
- Regular consumers of aquatic products have a higher level of acceptance
- Pro-environmental behaviours and knowledge of the sector are also positively correlated with acceptance



Acceptance level



POINTS OF DISCUSSION



A majority of consumers are willing to try new products



Some by-products and new species are easier to valorise



Consumers need support in making the transition

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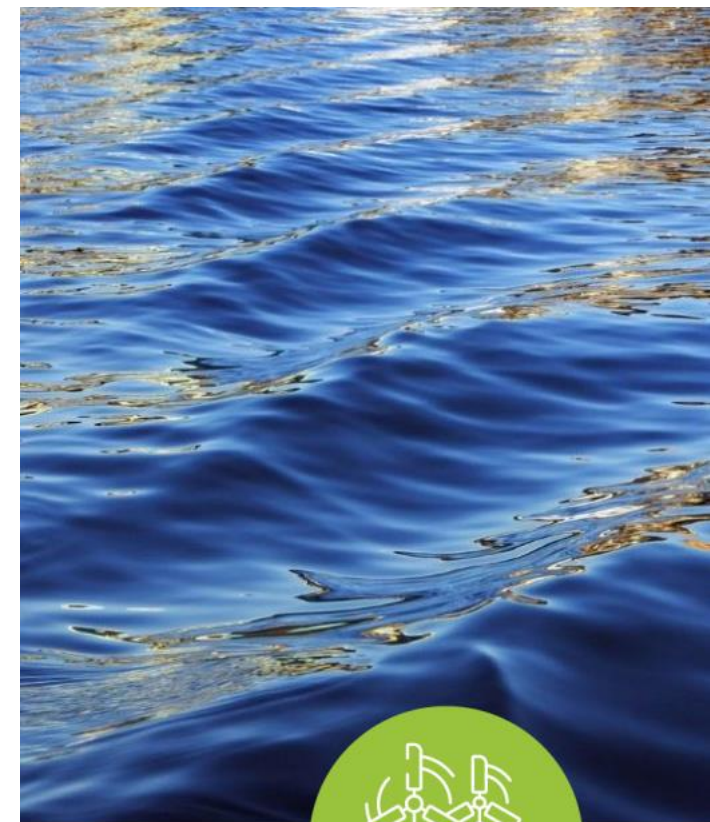
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How to raise awareness and foster social acceptance for new products?

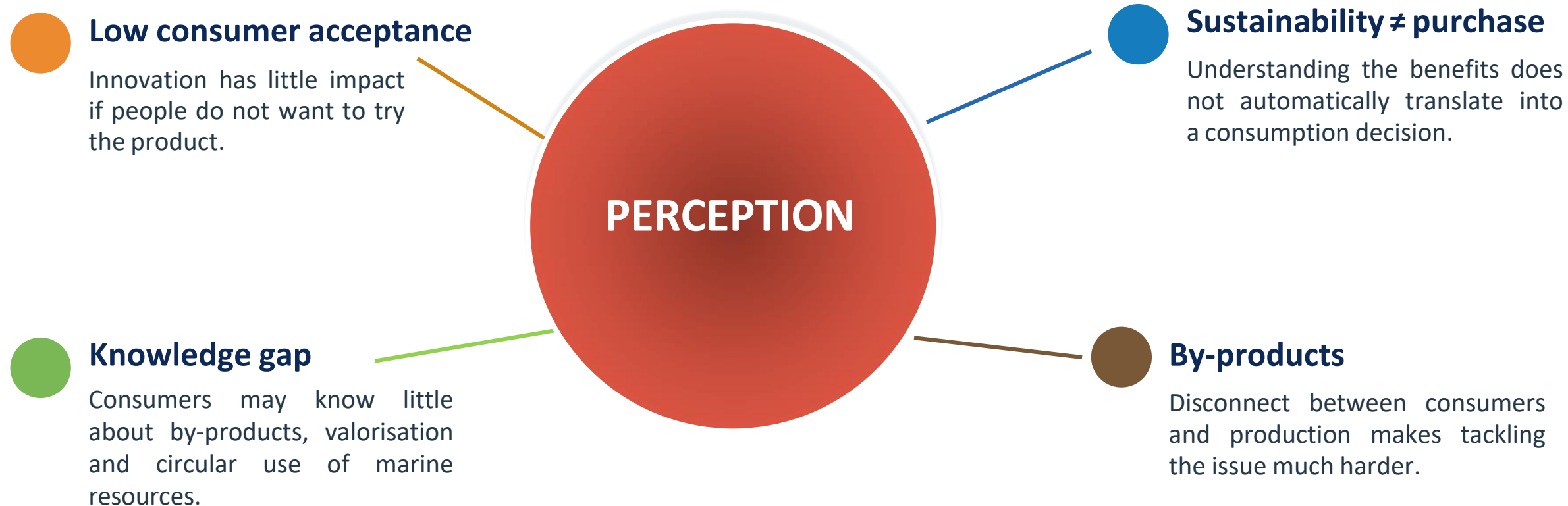
Lessons from AQUAFISH0.0 activities in Madeira, Portugal

César Gomes

24-09-2026



Acceptance starts before the first bite



Social acceptance is a pathway, not a single campaign

1

AWARENESS

Know it

Make the idea visible and understandable.

2

EXPERIENCE

Try it

Taste, visit, interact and ask questions.

3

TRUST

Believe it

Repeat contact through credible people and transparent information.

4

ADOPTION

Choose it

Make products practical, familiar and easy to use.

What we have done in Madeira



Interact

Schools



Experience

Fish-farm visits



Listen

Podcast



Taste

Culinary activities

**The value is in
the combination**

**Education builds
understanding**

**Experience reduces
distance**

**Tools sustain
engagement**

**Food creates
emotional
relevance**

*A single action creates a moment. A **connected set of actions** creates familiarity.*

Make sustainability tangible – and useful



Familiar

Present by-products in recognisable, appealing food formats.



Experiential

Let people taste, cook, visit and interact with the product story.



Practical

Give consumers tools they can use after the event.



Two-way

Listen to attitudes, barriers and preferences — not only communicate.



AQUAFISH Chef



Interreg
Atlantic Area
AQUAFISH



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the European Union

From acceptance to choice

Make it
understandable



Make it
desirable



Continuous effort.
Continuous contact.
Continuous learning.



Make it
accessible



Make it easy to
choose

For maximum
effect





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Thank you
Obrigada
Go raibh maith agat
Merci
Gracias

