



CORDIS Results Pack on **seafood**

A thematic collection of innovative EU-funded research results

February 2019

The background image is a scenic view of a lake, likely in Croatia, with mountains in the background and a small church on an island. In the foreground, a hand is holding a basket of fish and seaweed, and a fishing net is visible in the water.

**EU research and innovation driving
sustainable seafood production in
Europe and beyond**

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Editorial

Europe's marine and freshwater seafood will continue to play a key role in ensuring food and nutrition security (FNS). Sourcing food from our seas, oceans, rivers and lakes calls for a systems approach that prioritises sustainability, health and safety, fishers and farmers, consumers and citizens. All relevant economic sectors of the food system must be linked, from production to consumption, including processing industries, logistics, retailers and downstream food services. Such an approach must be deployed at all geographical levels – local, regional and national – as well as at European and international policy forums. Only in this way can global food security, quality and safety be ensured while fostering responsible research and innovation, and consumer acceptability of healthy and sustainable seafood.

The European Commission aims to tackle the FNS challenge through its FOOD 2030 research and innovation (R&I) policy framework with a view to 'future-proofing' our food systems to become more sustainable, resilient, responsible, inclusive, diverse and competitive. FOOD 2030 sets out a systemic approach that will connect, scale up and boost EU FNS R&I, providing solutions in four overarching food system priority areas: NUTRITION for sustainable and healthy diets; CLIMATE resilience and environmental sustainability; CIRCULARITY and resource efficiency; and INNOVATION and the empowerment of communities.

EU action on food

The FOOD 2030 framework addresses the provision and consumption of healthy and nutritious food products from marine and inland waters via capture-fishing practices and aquaculture. It supports the development of sustainable aquaculture in Europe and beyond, as a source of healthy protein in the fight against hunger and malnutrition, and as a means to meet an increasing global protein demand. Aquaculture stands out as a sector with high potential to create jobs and growth, as recognised by the EU Blue Growth Strategy. Key to the sustainable development of European aquaculture is good planning of marine and freshwater activities that considers social, ecological and economic dimensions and their impacts.

The sustainable management of traditional wild capture fisheries that eliminates wasteful or harmful activities will additionally ensure the preservation of healthy and productive marine ecosystems. Added measures are planned that will minimise unwanted bycatch and prevent discards. Initiatives throughout the EU will be developed to encourage the transfer of best practices across sustainable fisheries and aquaculture.

Highlighting the importance and scope of EU research

Funded under the EU's Seventh Framework Programme (FP7) and Horizon 2020 Framework Programme for Research and Innovation, these 13 cutting-edge EU-funded research projects highlight how our marine and freshwater ecosystems contribute to food safety and healthy and sustainable nutrition in the EU (and globally) and how they deliver on the four FOOD 2030 priorities. Furthermore, these initiatives play an important role in increasing the confidence of European consumers in European seafood and related products.



Interactive tools boost growth in the EU aquaculture industry

Only about 10 % of fish products consumed in EU countries originates from European aquaculture and another 30 % from its fisheries. The fact that the remaining 60 % is imported from abroad spotlights the need to increase aquaculture across Europe.

According to the Food and Agriculture Organization of the United Nations, aquaculture provides half of all fish for human consumption, with the highest related activity occurring in Asia. Meanwhile, consumption of fish products in developing countries is growing rapidly.

This growing demand for seafood is creating a critical food security risk in the EU that calls for a rapid increase in domestic production capacity. Moreover, there's little capacity in fish stocks to sustain any increase in capture fisheries. Hence, the

gap between production and consumption of aquatic products can only be bridged by aquaculture.

If EU production is to increase, the area occupied by aquaculture needs to expand. The EU-funded [AquaSpace](#) (Ecosystem approach to making space for aquaculture) project addressed this challenge by finding ways to increase the amount of suitable space available to aquaculture in marine and freshwater environments.



To achieve its goals, AquaSpace adopted an ecosystem approach to spatial planning for aquaculture in the context of EU directives and policies. “European aquaculture provides good-quality products, and respects stringent environmental sustainability, animal health and consumer protection standards,” says project coordinator Prof. Paul Tett. “Despite this, EU aquaculture production is static, unlike the strong growth experienced in other regions of the world.”

Toolbox to overcome social and environmental hurdles



By identifying and developing tools, specifying limitations and providing educational material, AquaSpace should help in enabling the aquaculture sector to grow sustainably and to effectively negotiate for space using MSP.

The consortium developed or improved a number of **tools** to support the spatial planning of aquaculture. Some of these tools integrate ecological, economic and sociological information on the environmental suitability for different types of aquaculture, the economic costs of setting up a farm and a variety of societal and regulatory issues.

Project partners tested the tools and explored spatial constraints through 15 **case studies** at 17 sites across Europe but also in Australia, China, New Zealand and North America. This involved the investigation of salmonid, perciform, freshwater carp and bivalve mollusc cultivation.

To gain better insight into the main factors restricting aquaculture expansion, researchers surveyed case study stakeholders on major barriers to aquaculture growth in their localities. They reported spatial, fish health, environmental and regulatory issues. Stakeholders also noted difficulties with the social acceptance of aquaculture, citing community opposition and conflicts with tourism and fisheries across a broad spectrum of different species and production methods.

More aquaculture space means sustainable development and increased production

Findings suggest two contrasting views on marine spatial planning (MSP) for aquaculture. “Is MSP a technical process that can be carried out more quickly and efficiently with the aid of tools such as those developed during AquaSpace?” asks Prof. Tett. “Or is MSP part of societal governance, with tools informing and empowering community agency and — hopefully — leading to greater societal acceptance of the expansion of aquaculture?”

Consortium members also used the experience gained in AquaSpace for educational purposes. They designed materials for a master’s-level **module** and a three-day continuing professional development **course** on planning and managing the use of space.

“By identifying and developing tools, specifying limitations and providing educational material, AquaSpace should help in enabling the aquaculture sector to grow sustainably and to effectively negotiate for space using MSP,” concludes Prof. Tett.

PROJECT

AquaSpace - Ecosystem Approach to making Space for Aquaculture

COORDINATED BY

The Scottish Association for Marine Science (SAMS)
LBG, UK

FUNDED UNDER

H2020

CORDIS FACTSHEET

cordis.europa.eu/project/id/633476

PROJECT WEBSITE

aquaspace-h2020.eu/





Novel seaweed products to combat iodine deficiency disorders

According to the World Health Organization, 40 % of the world's population is at risk from iodine deficiency. Seaweed is the best known and most reliable source of natural iodine, but production is dominated by larger Asian players, and seawater pollution affects product quality.

Iodine intake in Europe is low. In Germany alone, iodine deficiency is responsible for annual healthcare costs of nearly EUR 900 million. Furthermore, the market for iodine products is expected to steadily increase until 2020, with Europe being the main regional market.

The EU-funded [Blue Iodine II](#) (Boost BLUE economy through market uptake an innovative seaweed bioextract for IODINE fortification II) project produced new cost-effective seaweed iodine products to tackle iodine deficiency in three main target groups: children (aged from 7 to 14), pregnant and breastfeeding women, and older people.

These groups have a particular need for iodine intake: there's no product on the market specifically for children and older people, and no clear leader in products for natural iodine support to pregnant women or those that breastfeed. "We wanted to differentiate our product by specialising in the development of high-quality seaweed products based on protein enrichment with natural iodine that's rich in essential amino acids," says project coordinator Dr João Dionísio.

He explains that the seaweed is indigenous to Portugal's Macaronesian region where the project facilities and fish farms are located. It's naturally high in iodine and protein content, and very stable. The seaweed is ideal for processing as regards iodine extract production.

Favourable conditions conducive to seaweed development

Land production under sterile conditions generates seedlings that ensure a continuous supply of seaweed for production. Offshore cultivation allows a greater quantity of seaweed.

Project partners successfully developed and maintained propagules in the lab for one algae species. They carried out algae growth in small reactors that showed a good growth rate and produced enough raw material for replication and lab analysis. Then, they transferred the seaweed propagules to seawater tanks.



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We wanted to differentiate our product by specialising in the development of high-quality seaweed products based on protein enrichment with natural iodine that's rich in essential amino acids.

Researchers employed special facilities for seaweed cultivation in land-based tanks, and their proximity to the sea makes seawater available all year at minimal seawater-pumping costs. Seaweed production near offshore fish farms exploited waste from gilt-head (sea) bream which is rich in nutrients, and helped to avoid waste discharge into the marine environment.

Innovative biorefinery procedure for optimised production

Scientists also developed a biorefinery process to thoroughly exploit all the seaweed biomass using cold press extraction and filtering techniques to obtain purified extracts.

Market analysis and feedback from potential distributors revealed the need to demonstrate the iodine extract's benefits. In addition, clinical trials are under way with human subjects in order to validate product quality. The consortium is evaluating potential customers in target markets in Germany, Spain, France and Italy.

The seaweed iodine product (IODOBEM) has several novel features. "It's a natural extract that provides iodine and a broad range of nutrients, proteins, vitamins and minerals beneficial to human metabolism," claims Dr Dionísio.

The Blue Iodine II product offers clear benefits. "The extracted proteins possess essential amino acids and stabilise iodine during assimilation. Moreover, IODOBEM also avoids an overdose of mineral elements — namely sodium chloride — to give a natural product with clear advantages over products of inorganic origin."

PROJECT

Blue Iodine II - Boost BLUE economy through market uptake an innovative seaweed bioextract for IODINE fortification II

INTERVIEWEE INSTITUTION

Unidade de Bioquímica II Lda (UBQ), Portugal

FUNDED UNDER

H2020

CORDIS FACTSHEET

cordis.europa.eu/project/id/733552

PROJECT WEBSITE

ubqmadeira.com





European aquaculture to benefit from a better quality of live feed


The aquaculture sector is growing, with fish farming being a crucial means of ensuring Europe gets quality food without exploiting marine resources further. One key problem the industry faces is getting the immature fish through their first few months — and one EU project may be about to smooth the way.

Aquaculture is a growing market within the EU, bringing employment and providing a sustainable source of fish at a time when our marine life is under pressure. The main bottleneck for the production of marine fish occurs in the juvenile phase, especially during the period in which live diets are used. Even the established species, sea bream and sea bass, have a very low survival rate, at an average of 25 %. For new species in aquaculture, such as amberjack and tuna, the mortality is even higher.

The natural first feed for most fish larvae is crustacean nauplii, the offspring of many types of crustacean zooplankton. Fish larvae is evolutionarily adapted to such a diet, and it is believed that this type of prey fulfils the fish larva's nutritional requirements.

Planktonic AS, the company behind the [CryoPlankton2](#) (Cryopreservation of marine planktonic crustacean nauplii for innovative and cost-effective live feed diet in fish juvenile aquaculture) project, has developed novel and game-changing techniques, using marine crustacean nauplii both commercially and sustainably (CryoProduct). They have discovered a way to cryopreserve the nauplii in large user-friendly entities, and to revive them as live individuals after thawing.

"Our overall vision was to upscale, pilot and commercialise the innovative CryoPlankton production process for cryopreserved


One of the reasons for high mortality is the presence of pathogenic bacteria in conventional live feed diets. No pathogens have ever been detected in CryoPlankton, and fish producers have even medicated infected fish larvae with our product.

marine crustacean nauplii. This can replace conventional live feeds used at marine hatcheries," explains lead researcher Dr Nils Egil Tokle, of CTO Planktonic AS.

A large-scale, industrial trial showed that the vulnerable period during which larvae consume live feed could be greatly reduced in comparison to the time needed when the fish juveniles exist on diets commonly used at marine hatcheries.

"Traditionally, juveniles often display a high rate of deformities. These fish have a low market value and must be sifted out manually before going into sea cages," explains Dr Tokle, citing suboptimal feed as being the main reason for the low quality of juveniles. The rate of deformities in the last trial was extremely low, at less than 2 %. However, Dr Tokle is quick to point out that although the usual

rate is far higher, the controls were also low, so there was no statistical difference. "We do have strong indications that deformities are reduced, but we can't yet make that an absolute claim," he explains.

The project managed to scale up production more than they had estimated initially, producing more than 8 tonnes, and protocols developed at end-users' hatcheries resulted in fish juveniles which showed between 50 % and 100 % higher growth rates and far better rates of survival compared to the control treatments. The produced fish juveniles were better quality, with low deformities and high stress-resistance.



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Along with the benefits stemming from the quality of CryoPlankton, the project has found a way of making the process more environmentally friendly by reducing the amount of plastics normally associated with the process. "This is also much easier to use," says Dr Tokle. In the past, the hatcheries had to take out pouches of feed from a dewar flask (a double-walled flask of metal or silvered glass with a vacuum between the walls, used to hold liquids at well below ambient temperature). "This was a difficult task considering that the temperature inside was -196° Celsius. In addition, it was difficult to open the pouch as it became brittle in the liquid nitrogen."

Their system is also more efficient: it uses just one unit to thaw, wash and revitalise the nauplii, which means it is more practical to undertake at the end-user's location. The whole process takes just half an hour a day. "Conventional live feed diets," explains Dr Tokle, "require a lot of time and considerable skill."

But however good the feed, its use has to be simple and its distribution smooth. "We were also pleasantly surprised to see that delivering the product was relatively straightforward," explains Dr Tokle. The team sent out containers full of CryoPlankton to Greece, Portugal and Malta, with no hitches. "We used ordinary road transportation; there is no need for any special logistical effort."

The team believes CryoPlankton can help the aquaculture industry to overcome problems such as growth, survival, vitality and stress-response. "One of the reasons for high mortality is the presence of pathogenic bacteria in conventional live feed diets. No pathogens have ever been detected in CryoPlankton, and fish producers have even medicated infected fish larvae with our product," Dr Tokle says.

PROJECT

CryoPlankton2 - Cryopreservation of marine planktonic crustacean nauplii for innovative and cost-effective live feed diet in fish juvenile aquaculture

INTERVIEWEE INSTITUTION

Planktonic-AS, Norway

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/711906

PROJECT WEBSITE
planktonic.no/





Knowledge, tools and methods to reduce discarding in European fisheries

The EU has called for an end to the wasteful practice of returning unwanted catches to the sea when they can't be landed and sold. An EU-funded initiative developed the knowledge, tools and technologies, and gained the involvement of stakeholders and fisheries managers needed to achieve this goal.

The 2013 reform of the EU's Common Fisheries Policy (CFP) aims to gradually eliminate the wasteful practice of throwing away caught fish that are unwanted, by introducing the so-called landing obligation (LO), a ban on discarding. However, implementation of the regulation is challenging, and its feasibility, legitimacy and controllability is disputed.

Getting European fisheries to operate without discards

The Horizon 2020 [DiscardLess](#) (Strategies for the gradual elimination of discards in European fisheries) project addresses the short-term challenges and potential benefits, to support successful LO implementation. "Our focus is on preventing the unwanted catches from ever being caught, making best use of the unavoidable unwanted catch, and lastly on evaluating impacts of discarding on the marine environment, economy and society as a whole," says project coordinator Prof. Clara Ulrich.

From an ecological perspective, the food-web effects of the LO — where dead fish are landed rather than thrown back to the sea — are likely limited beyond seabirds and benthic scavengers. Banning discards implies landing and recording all catches, not just the commercial part of the catch. The intended ecological benefits of this include limiting the total mortality to the advised sustainable level and rebuilding stocks.



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In the short term, the LO will have substantial costs for fisheries. This is because there are no simple ways for fishers to fully select what's to be caught and what's to be avoided before the fishing gear is hauled on board. Discarding makes fisheries more cost-efficient. Over the longer term, however, reducing discards has the potential to increase profitability by promoting more sustainable fisheries.



Ultimately, the goal of DiscardLess is to support the implementation of the EU CFP towards sustainable fishing practices.

Discard mitigation strategies toolbox

Project partners also developed a series of tools, freely accessible online via a single repository that gathers, synthesises and disseminates the knowledge produced by DiscardLess. So far, tools include a [manual](#) of existing selective gear devices and their effectiveness, [proposed solutions](#) based on interviews featuring fishers' responses to LO regulations, and a [catalogue](#) containing over 30 valorisation products and a methodology for selecting the most promising ones in each case study. Also included is a [report](#) on possible on-board handling of unwanted unavoidable catches for four different fleet segments in 3D, together with a simple cost-benefit tool to estimate the economic feasibility of investing in the solutions.

According to Prof. Ulrich, the most significant output to date is "mobilising and expanding the vast multidisciplinary knowledge on all biological, technological, economic, political and institutional aspects linked to discarding" and "sharing it with all key fishery stakeholders during the LO legal implementation period from 2015 to 2018". All the main findings and outcomes are being collected in

an open-access book that will be published in early 2019 when the project ends.

"We want to ensure that the DiscardLess tools, information and strategies provide relevant, acceptable and cost-effective means with a wide uptake in society that will contribute to meeting the LO goals," concludes Prof. Ulrich. "Ultimately, the goal of DiscardLess is to support the implementation of the EU CFP towards sustainable fishing practices."

PROJECT

DiscardLess - Strategies for the gradual elimination of discards in European fisheries

INTERVIEWEE INSTITUTION

Technical University of Denmark, Denmark

FUNDED UNDER

H2020

CORDIS FACTSHEET

cordis.europa.eu/project/id/633680

PROJECT WEBSITE

discardless.eu





Fishing for new ways to expand the EU's aquaculture industry

The EU-funded DIVERSIFY project is contributing to the sustainable expansion of the Europe's aquaculture industry by promoting species diversification and product development.

Currently, aquaculture in Europe is unable to meet the growing demand for aquatic products. In fact, the European aquaculture sector only provides an insufficient 10 % of the EU's total seafood consumption. Seeing an opportunity to help increase the sector's market share, the EU-funded DIVERSIFY (Exploring the biological and socio-economic potential of new/emerging candidate fish species for the expansion of the European aquaculture industry) project is working to expand the EU's aquaculture industry. It is revolutionising scientific techniques and methodologies that will optimise the rearing and production of new or emerging finfish species and establishing a range of marketing initiatives aimed at attracting consumers.

"The objective of the DIVERSIFY project is to promote the species diversification of the European aquaculture industry, thus contributing to its sustainable expansion," says project coordinator Dr Constantinos C. Mylonas.

Six promising species

The project identified six new or emerging finfish species: meagre, greater amberjack, wreckfish, Atlantic halibut, grey mullet and pikeperch. "Because these species are either large or fast-growing, they are ideal candidates for processing into a range of products, providing consumers with both a greater diversity of choice and new value-added products," explains Dr Mylonas.

However, before these new products could be launched, researchers first had to resolve such production bottlenecks as reproduction control, larval rearing methods, optimisation

of recirculation aquaculture system rearing, feeding methods, and identifying major pathogens. For example, in the case of greater amberjack, researchers had to develop innovative methods for controlling their reproduction in captivity, the on-demand production of fertilised eggs, and the production of large numbers of juvenile fish. "We are finally at the stage, after decades of interest and scattered efforts for commercialising this species in Europe, that we can now proceed with industrial production and marketisation," says Dr Mylonas.

Another example is the researchers' success in making the meagre (originally an emerging species) a viable market option for the aquaculture sector. Having confirmed that the available captive broodstock was adequate for breeding selection programmes, researchers developed the husbandry and molecular tools needed to implement this selection at farm level.

In addition to its species-specific research, the project also includes a socioeconomic component. Here, researchers are looking at market opportunities for the new species and developing business models based on consumer studies and online marketing tests, among other tools. So far, insights have been generated to identify the most promising ideas for new fish products from the project species for the European market.



The DIVERSIFY project has demonstrated that diversification is not only possible, but a necessity for European aquaculture.



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Objectives met

DIVERSIFY has produced an range of important scientific knowledge that is helping European aquaculture diversify its production and increase its market share. "The DIVERSIFY project has demonstrated that diversification is not only possible, but a necessity for European aquaculture," says Dr Mylonas.

The consortium is now turning its attention towards the future, identifying the research needed to address additional production bottlenecks. DIVERSIFY's goal has been achieved: to provide the necessary tools to diversify the European aquaculture industry and ensure food security, sustainable production and high-quality seafood at an affordable price.

PROJECT

DIVERSIFY - Exploring the biological and socio-economic potential of new/emerging candidate fish species for the expansion of the European aquaculture industry

INTERVIEWEE INSTITUTION

Hellenic Centre for Marine Research, Greece

FUNDED UNDER

FP7-KBBE

CORDIS FACTSHEET

cordis.europa.eu/project/id/603121

PROJECT WEBSITE

diversifyfish.eu/





Sustainable water treatment solutions for aquaculture

A Spanish small and medium-sized enterprise (SME) is taking fish farming to the next level by creating novel water-treatment systems suitable for recirculating aquaculture systems. The turnkey solutions create a controlled setting to optimise growth and overall fish survival.

Global demand for fish has more than doubled over the last 50 years, and is expected to keep rising with global population growth. To address this increasing worldwide appetite for seafood, farmers and companies are pinning their hopes on aquaculture, which has grown more rapidly than any other realm of animal production.

The EU-funded [ELOXIRAS](#) (Electrochemical oxidation in the recirculating aquaculture systems industry) project developed an innovative recirculating aquaculture system (RAS) technology based on cutting-edge electrochemistry

and a design philosophy that eliminates biological treatment, disposable filters and the need to add chemical reagents. The RASs are indoor, tank-based systems that provide a controlled and biosecure environment for cultivating fish.

The consortium, which comprised the Spanish SME APRIA Systems together with two other project partners, utilised proven electrochemical oxidation technology. “The overall global water treatment equipment market is expected to grow over the next few years,” says Sara Domínguez, sales engineer at APRIA Systems.



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Radical new approach

The majority of water treatment solutions for recirculating aquaculture systems typically employ biological methods to maintain water quality. “Biofiltration is a prominent component in recirculating systems and is used to metabolise ammonia excreted by fish into less toxic forms. However, the process shows limited efficiency in capturing and degrading other key pollutants,” explains Domínguez. What’s more, major fluctuations can occur in the efficacy of the process, due to environmental perturbations or changes in operating conditions.

Additional chemical water-treatment methods are used in tandem with biofiltration to keep pollutant concentration below a certain threshold. For example, use of ultraviolet or ozone treatment systems reduces the number of free-floating viruses and bacteria in the system water.



Our new series of products called ELOXIRAS® produce a powerful mix of oxidants that remove ammonia nitrogen, nitrite and dissolved organic matter. They simultaneously achieve high disinfectant efficacy (removal of bacteria and viruses).

"Our new series of products, called ELOXIRAS®, produce a powerful mix of oxidants that remove ammonia nitrogen, nitrite and dissolved organic matter. They simultaneously achieve high disinfectant efficacy (removal of bacteria and viruses) and lower freshwater intake consumption by 20 %," notes Domínguez. Moreover, the technology can treat large volumes of water with minimal environmental impact and without the use of hazardous chemicals. In addition, ELOXIRAS® products automatically adjust treatment intensity depending on the cultured biomass concentration and the hourly change in the pollutant rate production.

Tailor-made solutions

The modular and scalable design of ELOXIRAS® products enables them to prove their versatility in various applications, depending on their size. Furthermore, they are easy to operate without displaying any efficacy fluctuations or requiring long start-up periods.

ELOXIRAS® HYBRID is designed for large recirculating aquaculture facilities and treatment flows. It increases biomass system capacity up to 50 % without increasing the recirculation rate. Typical culture volume capacities can range between 20 and

several thousands of cubic metres, whereas biomass densities can reach over 30 kilograms per cubic metre. By contrast, ELOXIRAS® MINI is designed for small-scale facilities.

Thanks to its compact design and low power consumption, ELOXIRAS® LOGISTIC is a perfect fit for portable applications. In particular, its use in logistics operations ensures excellent transport conditions from hatcheries to fish farms. Finally, ELOXIRAS® BIO improves the culture capacity of quarantine systems, minimising the risk of diseases being spread in recirculating aquaculture facilities.

PROJECT

ELOXIRAS - Electrochemical Oxidation in the Recirculating Aquaculture Systems Industry

INTERVIEWEE INSTITUTION

APRIA Systems S.L., Spain

FUNDED UNDER

H2020

CORDIS FACTSHEET

cordis.europa.eu/project/id/698494

PROJECT WEBSITE

eloxiras.com/





The next level in European finfish breeding

There is a pressing need to improve aquaculture production, because of the growing global population. The multidisciplinary FISHBOOST initiative proposed to improve European aquaculture production through optimised breeding programmes.

Breeding schemes for the main European finfish species vary with respect to size, structure and technological level. There is a tendency towards genetic improvement of farmed finfish to increase aquaculture efficiency and profit.

The EU-funded [FISHBOOST](#) (Improving European aquaculture by advancing selective breeding to the next level for the six main finfish species) project, a collaborative research effort with industry, considered the main components of breeding programmes for Atlantic salmon, common carp, European sea bass, gilthead sea bream, rainbow trout and turbot.

FISHBOOST brought together leading scientists from 14 institutions and 11 companies. As project coordinator and senior scientist at Nofima, Dr Anna Sonesson explains, “the main goal of FISHBOOST was to improve the efficiency and profitability of European aquaculture by advancing selective breeding to the next level for each of the six main finfish species through collaborative research with industry.”

Innovative tools for fish breeding

In commercial aquaculture, diseases caused by viruses, parasites or bacteria have a major economic impact and result in mortality or reduced productivity, or necessitate costly treatment. Moreover, disease outbreaks negatively affect fish welfare, and if the marine and freshwater environments are affected, they threaten wild fish populations.

FISHBOOST investigated genome-wide genetic markers for disease, undertaking the largest genotyping-by-sequencing study of aquaculture species in the world, to date. Researchers generated single-nucleotide polymorphism marker databases and genetic linkage maps, and calculated estimates of heritability for diseases for the most common finfish.

A genetic epidemiology study on turbot demonstrated that variation in disease resistance can be expressed in terms of tolerance, resilience and infectivity. Mapping the genetic variation allowed scientists to select species with enhanced disease resistance, thereby improving existing aquaculture breeding programmes.

The project also validated and implemented lipid-related traits as production efficiency indicators such as fillet yield. These lipid-related traits serve to genetically improve winter survival in common carp. Furthermore, selective breeding for feed development allows selection of fish genetically capable of adapting to challenging diets that involve increasing amounts of multiple ingredients.

Using the FISHBOOST data sets, genomic methodologies increased fish selection accuracy by up to 22 %, compared to traditional practices. Furthermore, the genomic selection methods specific to each of the six species provided economic benefits. FISHBOOST also developed the BASEPOP software for selecting individuals for new aquaculture breeding programmes, while the FISHBOOSTSEL tool maximised genetic gain by helping assign matings to different tanks.

The future of selective breeding

The project successfully highlighted to stakeholders and fish farmers the importance and usefulness of selective breeding in achieving sustainable aquaculture. Through novel tools and traits included in the breeding objective, researchers emphasised the need for exploiting the biology and genetics of the species with maximum breeding potential.



The main goal of FISHBOOST was to improve the efficiency and profitability of European aquaculture by advancing selective breeding to the next level for each of the six main finfish species, through collaborative research with industry.



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Improving breeding practices, adapting methods to new standards and including new traits is the way forward for a sustainable and profitable aquaculture industry. Importantly, the FISHBOOST tools have the potential to improve fish welfare by reducing disease outbreaks, while higher productivity may lead to reduced prices for aquaculture products. Dr Sonesson is hopeful that “the industry will implement the FISHBOOST-generated knowledge and tools to improve aquaculture production”.

PROJECT

FISHBOOST - Improving European aquaculture by advancing selective breeding to the next level for the six main finfish species

INTERVIEWEE INSTITUTION

Nofima AS, Norway

FUNDED UNDER

FP7-KBBE

CORDIS FACTSHEET

cordis.europa.eu/project/id/613611

PROJECT WEBSITE

nofima.no/en/prosjekt/fishboost-2/





A novel nutritional supplement against cancer cachexia

Cancer is a leading cause of mortality around the world and treatment can often leave patients malnourished. European researchers developed a novel omega-3 fatty acid formulation as a nutritional supplement for chemotherapy patients.



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Eicosapentaenoic acid (EPA) is a polyunsaturated or omega-3 fatty acid obtained by eating fish. It is an essential nutrient, as it constitutes an integral component of the cell membrane and can help lower triglyceride levels. Traditionally, EPA is administered for protection against high cholesterol and heart disease.

EPA benefits against cancer cachexia

During cancer progression, patients experience impaired response to anti-neoplastic therapy, alongside weight loss, a major prognostic indicator of poor patient survival. Furthermore, following chemotherapy, cancer patients tend to suffer from malnutrition, anorexia and cachexia, which significantly hamper their recovery. There is a need for effective nutritional intervention that improves body composition and preserves muscle mass and muscle quality.

The objective of the EU-funded [LIFEOMEGA](#) (Innovative highly concentrated Omega-3 specialized nutrition product) project was the industrial and market development of a highly concentrated EPA supplement. "We support cancer patients' recovery through nutrition with a concentrated EPA emulsion supplement," says R&D director of Solutex, Dr Laura Gil.

Data from other studies suggest that EPA has wide clinical benefits for cancer patients. Several mechanisms of action of EPA propose a decrease in tissue inflammation, for example via modulation of pro-inflammatory cytokines and stimulation of protein synthesis through enhanced insulin sensitivity. In addition, EPA may help increase calorie intake, thereby improving patients' nutritional status and reducing cachexia.

A unique EPA formula

The uniqueness of the product lies in its emulsion formula, which means that LIFEOMEGA can be conveniently delivered in other liquids, making it easier to swallow than pills or capsules. These features make the LIFEOMEGA EPA a complete breakthrough medical food in the essential nutrition market, both in Europe and in the US.

Researchers had to meet the technical challenge of finding the right balance between a high dose of EPA and an agreeable taste that patients would accept. LIFEOMEGA EPA is flavoured to mask the fishy taste, and has the highest concentration of EPA in the market, facilitating the ingestion of 3 grams of EPA per day in a single 20 millilitre emulsion dose.



We support cancer patients' recovery through nutrition, with a concentrated EPA emulsion supplement.

Alongside the positive impact on the nutritional status of patients, EPA is believed to have a positive effect on the resolution of inflammatory processes caused by chemotherapy. "Results from pharmacokinetic studies show that our proprietary emulsion improves the bioavailability of EPA in the body," explains Dr Gil. In addition, the LIFEOMEGA emulsion is currently being tested in other clinical trials to assess the level of nutritional improvement in patients and the biological activity of the product. The diverse pathology of cancer patients necessitates clinical data to evaluate the impact of the product and help clinicians provide the best nutritional advice on an individual basis.

According to Dr Gil, "the most significant achievement of the project has been the interest and support by oncologists, who already see the uniqueness of the emulsion and its potential benefits for their patients." As the LIFEOMEGA product was designed to improve the health of cancer patients, it is expected

to aid the outcome of treatment by facilitating patients' recovery, reducing the length of their hospitalisation and improving their quality of life.

PROJECT

LIFEOMEGA - Innovative highly concentrated Omega-3 Specialized Nutrition Product

COORDINATED BY

Solutex GC SL, Spain

FUNDED UNDER

H2020

CORDIS FACTSHEET

cordis.europa.eu/project/id/755889

PROJECT WEBSITE

www.lifeomega.eu





Minimising bycatch in European commercial fisheries

The modern, versatile methods now used to catch fish compound an age-old problem — the unintentional catching and killing of unwanted marine species. An EU-funded project has demonstrated enhanced technologies and practices that help reduce amount of unwanted catch.



According to certain estimates, over 7 million tonnes of fish are discarded at sea every year. While the practice has been discouraged by EU Member States, it was not until major reforms to the CFP were secured that a ban was formalised. As of 2019, the discard ban (LO) will end once and for all the commercial fishery practice of throwing non-target and undersized species back overboard.

The Horizon 2020 [MINOUW](#) (Science, technology, and society initiative to minimize unwanted catches in European fisheries) project addressed the complexity in implementing the landing obligation in south European fisheries. The project provided policy recommendations that aim to incentivise selective fishing and the best use of unwanted catches brought on land. It also demonstrated several new technical solutions for reducing preharvest mortality and post-harvest discards, while avoiding damage to sensitive marine species and habitats.

Gearing up for change

Despite the incremental introduction of the landing obligation over the last four years, fisheries remain relatively underprepared for its implementation. “The lack of incentives to gradually progress to more rational exploitation of fishery resources and the limited means of EU control make it difficult for [fishers] to fully comply,” explains project coordinator Francesc Maynou.

Our ‘early-slipping’ procedure helped survival rates of discarded small sardines increase from 20 % to 70 %.

Researchers identified the improvement of gear selectivity as a viable option for making the fishing industry less reluctant to change its practices. The new practical and affordable solutions not only help fishers prevent unwanted catches in the first place, but also increase the survival rate of the released organisms.

To improve selectivity in bottom trawling, project partners tested extension pieces such as square-mesh and T90-mesh nets. Both net configurations create an escape panel in an existing diamond mesh cod-end for non-target or undersized target species. “Results from field-trial tests in Catalonia were positive: the T90 panel allowed more than 50 % of small hakes and red mullets to escape,” reports Maynou.

Modifying trammel nets by attaching a guarding net to the footrope of the trammel was another innovative solution that proved successful in reducing bycatch by 50 % in small-scale coastal fisheries. This type of sorting grid is specifically designed for Mediterranean trawls and reduces handling time and net damage.

Results from using a modified slipping technique during purse seine operations in Portugal demonstrated very high survival rates for slipped pelagic fish. “Our ‘early-slipping’ procedure helped survival rates for discarded small sardines to increase from 20 % to 70 %,” adds Maynou. A newly developed ‘juvenile-excluding device’ helped cut down unwanted bycatch of hake, red mullet, deep-water rose shrimp and horse mackerel by 50 % to 70 %, depending on the species.



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Fishing monitoring

Precise understanding of the spatial footprint of fisheries increases the ability to quantify the negative impact of fishing and better protect certain sea areas.

MINOUW's new geographic information system is an invaluable tool for marine researchers and represents a major step towards more sustainable fisheries. It reduces unwanted catches and discards using satellite data, maps and observations. The software combines maps of potential high-density discard areas with 'fisheries footprint' spatial information. This spatial selectivity assists marine planning by establishing temporary closed areas where fishing is not allowed for a certain period of time.

The portfolio of innovative technical solutions delivered by MINOUW offers the possibility for Europe to end the controversial practice of discarding fish, while remaining attractive to fishers, fishery managers, policymakers and industry.

PROJECT

MINOUW - Science, Technology, and Society initiative to minimize Unwanted Catches in European Fisheries

COORDINATED BY

Spanish National Research Council (CSIC), Spain

FUNDED UNDER

H2020

CORDIS FACTSHEET

cordis.europa.eu/project/id/634495

PROJECT WEBSITE

minouw-project.eu/





Decision support framework for sustainable aquaculture and fisheries

Fish farming is one of the fastest growing food sectors worldwide, but in Europe, the sector is stagnating and seafood imports are rising. An EU-funded project unveiled an advanced toolbox for reducing market risks and netting a secure economic future for the European seafood companies.

Aquaculture accounts for around 10 % of fish production in EU, fisheries for about 25 %, and imports from countries outside the EU for 65 %. Although EU aquaculture is renowned for its high quality, environmental sustainability and consumer protection standards, the overall output has been relatively constant in volume since 2000, partly because products have not been cost-competitive compared with imports. At the same time, global production has been growing by nearly 7 % per year.

The EU-funded project [PrimeFish](#) (Developing innovative market orientated prediction toolbox to strengthen the economic sustainability and competitiveness of European seafood on local and global markets) has been established to help increase the sector's production and competitiveness. The consortium introduced an innovative decision support framework that includes forecasting models and market intelligence tools for boosting the competitiveness and economic sustainability of the European seafood industry.



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A wide-ranging analysis of Europe's fish market uncovered critical factors and bottlenecks that restrain market growth of six fish species: herring, cod, salmon, freshwater trout, sea bass and sea-bream. The project analysed consumer behaviour and market trends in the main European seafood markets. It explored price fluctuations, government regulations regarding seafood trading, why seafood products fail on markets, and why the industry is not meeting current consumer demand and expectations.

Prime toolbox

Researchers used data collected from individual production companies, industry and sales organisations, consumers and public sources to verify models and develop prediction algorithms. "Our models can analyse changes in the competitiveness of the sector or how changes in the demand and supply chain determine prices. They can also estimate the willingness of consumers to pay for specific features of seafood products," says project coordinator Guðmundur Stefánsson.

The models were integrated into a decision support system called PrimeDSS. PrimeDSS, together with the underlying data, user instructions and guidelines form the PrimeFish decision support framework (PrimeDSF). This will enable fishers, aquaculture producers and other stakeholders to understand and predict seafood market behaviour. But what does this innovative toolbox contain?

Specialised marketing and economic tools

PrimeFish conducted market studies involving close to 6 000 seafood consumers from 5 European countries, offering the seafood sector a deeper insight into their preferences and willingness to pay for fresh fish and their reactions to negative information published via different media.

"Our new marketing tool, called 'Product Success Check', matches product attributes to specific consumer groups to improve the likelihood of successfully launching a new seafood product on the market," explains Stefánsson. As he further explains, the fail

rate for new seafood products is very high, and the processes of product development and market entrance are very cost-intensive and financially risky.

The second marketing tool developed by PrimeFish, called 'Willingness To Pay', identifies the willingness of consumers to pay for salient product attributes — wild caught or farmed fish, health claims and sustainability labelling.

Another feature of PrimeDSS is the 'Competitive Position Analyser'. This economic tool identifies where Europe's aquaculture and fishery industries stand compared to their peers. Yet another tool, the 'Growth Risk Analyser', outlines price behaviour and identifies warning indicators signalling a boom-and-bust cycle.

With no other similar decision-support tools available on the market, PrimeFish aims to significantly improve the competitiveness and economic performance of Europe's aquaculture sector. The market and economic tools will be commercially exploited after the project's end by a project partner.



Our models can analyse changes in the competitiveness of the sector or how changes in the demand and supply chain determine prices. They can also estimate the willingness of consumers to pay for specific features of seafood products.

PROJECT

PrimeFish – Developing Innovative Market Orientated Prediction Toolbox to Strengthen the Economic Sustainability and Competitiveness of European Seafood on Local and Global markets

COORDINATED BY

Matis OHF, Iceland

FUNDED UNDER

H2020

CORDIS FACTSHEET

cordis.europa.eu/project/id/635761

PROJECT WEBSITE

primefish.eu/





A green approach against sea lice

The sea-farming industry is undergoing technological advancement, including the incorporation of digitalisation and prediction tools. Through an innovative system, the SPG project aims to prevent sea lice infection and improve fish farming.

Infection by the parasite *Lepeophtheirus salmonis* or salmon louse presents a major challenge to the health of the sustainable aquaculture industry. This copepod crustacean feeds on salmon's skin and blood to survive. Although finding a host in the wild is difficult for the parasite, in fish farms the high fish density facilitates lice infestation, leading to commercial damage.

An innovative approach

Undoubtedly, the industry needs to invest in preventive yet environmentally friendly measures alongside tools for certifying the health of fish in professional sea farms. The EU-funded SPG project was designed to validate a unique, chemical-free and cost-effective approach for preventing sea lice infestation in salmon farms. "Our approach is based on the Seafarm Pulse Guard (SPG) patented technology that employs electrical pulses to inactivate crustacean parasites before they attach to the fish," says project coordinator and Seafarm Development AS (SFD) CEO, Stein Åge Davidsen.

The SPG system consists of vertical cables that surround the fish cage mesh and transmit power pulses horizontally in the water. The duration and frequency of the pulses can be controlled to stop infestation within the cage and prevent it spreading into the surrounding marine ecosystem. Results so far demonstrate a 90 % reduction in sea lice infestation, representing a significant saving in treatment costs.

"Our main focus was to verify the potential of the technology as a more sustainable parasite control approach for fish," continues Davidsen. Project partners had to overcome a number of technical issues associated with the power input to the electrodes and optimised subsystem technologies. The developed prototype was subsequently validated in a large-scale, real-life environment.



Our approach is based on the Seafarm Pulse Guard (SPG) patented technology that employs electrical pulses to inactivate crustacean parasites before they attach to the fish.

Researchers tested the technology on commercial sites of the sea-farming company Bolaks in Norway for one cycle of salmon breeding, with extremely satisfactory results.

The future of the SPG technology

The main advantage of the SPG system is that it has no environmental impact. While most technologies against sea lice are reactive and involve harsh chemicals, which damage or weaken fish, the SPG green technology leaves fish untouched. In addition, SPG is compliant with the strictest fish welfare standards, while reducing overall operational costs by 20 %. Furthermore, there is no possibility of the parasites developing resistance to the treatment as is the case with certain drugs or chemicals.



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According to Davidsen, partners are currently “looking for industrial investors to expand beyond the Norwegian market, in Europe, North America and Chile”. He is confident regarding the future of the SPG technology: “SPG will be the only preventive solution in the market capable of increasing the sustainability of existing sea salmon farming sites.” Existing commercial agreements with Norwegian sea-farming companies allow SFD to be hopeful for the future of the technology, with an expected revenue of EUR 84 million and accumulated profits projected to reach EUR 42 million by the end of 2023.

Considering that fish farming is required as part of the drive to meet the demand of the world’s expanding population, addressing the issue of salmon lice is of paramount importance. SPG proposes a methodology for treating infection outbreaks that improves the marketability of farmed fish and does not damage marine ecology.

PROJECT**SPG – Seafarm Pulse Guard**

COORDINATED BYSeafarm Development (SFD) AS, Norway

FUNDED UNDERH2020

CORDIS FACTSHEETcordis.europa.eu/project/id/756150

PROJECT WEBSITEsfd.no/



New policies and innovations to boost European seafood sector

The taste for European seafood is steadily increasing, both at home and abroad, but environmental pressures are compromising supply which is dependent on fisheries and aquaculture. A more sustainable and financially viable model is therefore needed in Europe's seafood sector.

Europe is looking to strengthen the competitiveness of its fisheries and aquaculture industries to meet increasing demand. Against this background, the EU-funded [SUCCESS](#) (Strategic use of competitiveness towards consolidating the economic sustainability of the European seafood sector) project worked on strengthening the competitiveness of the European fisheries and aquaculture industries by conducting key research along the full value chain, i.e. from the fishing net (producers) to the plate (consumers).

This couldn't have come at a better time, since growing environmental concerns have begun to affect consumer purchasing behaviour. "Consumer preferences for seafood vary

considerably among countries and markets," says Dr Bertrand Le Gallic, assistant professor in economics at the French University of Brest, which coordinated the project. "There is certainly a market for sustainably and locally produced seafood, presenting an important opportunity for the producers," he adds.

Good results on the ground

Competitiveness can be promoted by enhancing cooperation among producers, processors and relevant organisations and by differentiating the product based on quality, origin, processing and convenience. In one case study, the project consolidated



cooperation among scallop producers in Galicia, Spain, bringing producer organisations closer to processors to create a fresher, more premium product. “The [fishers] sell to the company at a negotiated price, which beats selling by auction, yielding a high-quality product,” illustrates Dr Le Gallic.

The project also demonstrated the importance of convergence in aquaculture between key European countries and non-EU countries such as Turkey. “Non-EU companies don’t necessarily need to comply with the high EU standards at production level,” states Dr Le Gallic. In some cases, establishing safeguards such as non-tariff measures can protect against unfair competition.

SUCCESS also stressed the need to address the lack of information across the seafood value chain regarding quality and benefits. “Increasing and improving communication regarding quality and product at every level of the value chain can benefit both producers and consumers,” insists Dr Le Gallic, highlighting the example of a training programme developed by the Spanish government for work at retail seafood counters.

Recommendations for better policies

SUCCESS identified a need for policies to address the heterogeneity of the seafood value chain. “Since the seafood industry is well diversified by species, countries and production systems, it can benefit from more tailored policies, as generic policies may be ineffective or even harm the industry,” explains Dr Le Gallic.

There is also a need to improve consumer knowledge and traceability, particularly in places where consumers aren’t very familiar with seafood products. Dr Le Gallic proposes, for example, “introducing labels of origin on seafood as many consumers would be willing to pay more for differentiated products from specific countries.”



There is certainly a market for sustainably produced seafood, presenting an important opportunity for the producers.

Overall, the EU can simplify legislation and promote policy coherence for advancing aquaculture, e.g. through an enhanced regulatory framework. This could include, for example, fairer implementation of Marine Spatial Planning, so as to prevent competition with the tourism sector. Simplifying licensing procedures and harmonising environmental impact assessments would also be useful, as would facilitating regulations to establish new industry facilities.

Cohherence between EU quality schemes and EU organic labelling — such as shellfish farming — is pivotal, as is promoting innovation in the field. One SUCCESS partner developed new innovative mussel products using natural preservatives. “The extended shelf-life of these products helps producers to reach remote markets and compete with imported mussels in the domestic markets,” says Dr Le Gallic.

Lastly, measures should be put in place to compensate for positive societal impacts at the expense of the fishing industry. Examples include losses in carp due to predators from protected birds or due to touristic attractiveness of areas which limits aquaculture and fishing.

There is no doubt that policies and innovative products can render the sector more competitive and sustainable.

PROJECT

SUCCESS – Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood sector

COORDINATED BY

University of Western Brittany, France

FUNDED UNDER

H2020

CORDIS FACTSHEET

cordis.europa.eu/project/id/635188

PROJECT WEBSITE

success-h2020.eu/





Ultrasound for fish processing

Managing European fish stock is of paramount importance, given the need to conserve marine resources and produce sufficient fish products. An EU-funded initiative has developed ultrasound technology to preserve fish before they reach the market.



© Natalia Escursell Arcega

Preparation of whole fish for human consumption requires immediate and proper handling as well as preservation, in order to retain fish quality. Usually, fish is stored at low temperatures to slow down the growth of microorganisms, and this is followed by immediate freezing or processing.

However, deterioration of the product before it reaches the consumer is not uncommon, and may lead to significant waste of fish resources, necessitating more rapid and efficient processing approaches. At the same time, there is a high demand for cleaner, organic products without the use of additives.

A well-established technology in the fish industry

Coordinated by Scanfisk, a Spanish company specialised in fish processing of fresh and frozen products, the Horizon 2020 ULTRAFISH (Eco-innovative processing technology for better quality better quality and shelf life of fish products) project aimed to improve current handling and processing of fish products using green technology. "We wanted to eliminate the use of chemical additives for microbial inactivation in fish products," explains project manager and quality technologist of Scanfisk, Natalia Escursell.

The idea was to develop an ultrasound-based method to reduce fish processing times (washing, thawing and rehydrating) as well as the generation of water waste. Ultrasound technology is based on mechanical waves at a frequency above the threshold of human hearing, and can be categorised into two frequency ranges depending on the energy output.

Ultrasound is a well-established preservation technique applied in many food-processing fields, e.g. in the preharvest and post-harvest phases of fresh vegetables and fruits, in cheese processing and in frozen foods. In addition, ultrasonication is known to inactivate various pathogens, providing effective pasteurisation and preservation of flavours and colours. However, it has yet to be developed for fish processing applications.

ULTRAFISH optimised ultrasound technology for use in fish processing, with promising results at the laboratory and pilot plant levels. The prototype has produced neutral products of high quality in accordance with market demand. Currently, it is being validated for industrial scale and optimised for decreased production times.

The impact of ultrasound on fish processing

Implementation of the ULTRAFISH approach is expected to increase the commercial shelf-life of fish products for up to five extra days while saving time, money and energy. According to Escursell, “the technology will contribute to a sustainable production, while significantly reducing up to 20 % the food waste generated in the supply chain.”

The use of ultrasound is rapidly expanding throughout Europe and North America, as a technique for safeguarding the safety of food products while maintaining product quality. From an economic perspective, the ULTRAFISH technology is expected to be highly beneficial for fish-processing companies, increasing their production capacity by 35 % with up to 50 % savings and a 2 % increase in their margin. This translates into a higher market share of the fish-processing industry and distribution of higher value-added products in the market.

Considering the limited supply of natural fish stocks, the industry must implement technologies for efficient utilisation of available raw materials. Overall, ULTRAFISH has responded to the challenge of extending the life of the product in a completely

natural way. Escursell emphasises that “this has been made possible only with the help of the European Commission, providing us with the opportunity to work with one of the best research centres in Europe in food research, the Faculty of Veterinary Medicine of the University of Zaragoza.”



We wanted to eliminate the use of chemical additives for microbial inactivation in fish products.

PROJECT

ULTRAFISH – ECO-INNOVATIVE PROCESSING TECHNOLOGY FOR BETTER QUALITY AND SHELF LIFE OF FISH PRODUCTS

COORDINATED BY

Scanfisk Seafood SL, Spain

FUNDED UNDER

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RESEARCH*EU MAGAZINE ISSUE 78: A secure and high-quality food system, from farm, factory, to fork

In this issue of Research*eu magazine, following a number of high-profile safety scandals over the past few years, we dive deeper into how seven EU-funded projects are helping to ensure not only the safety of the EU's food system but also the highest quality of food for European consumers to choose from.



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