AQUA EXCEL 2020

AQUAculture infrastructures for EXCELlence in European fish research towards 2020

Project News

ISSUE 7 SEPTEMBER 2019

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AQUAEXCEL[2020] is a €9.7 million European Union-funded Horizon 2020 research infrastructure project that aims to support the sustainable growth of the aquaculture sector in Europe. It does so by integrating the European aquaculture community, and providing it with crucial tools, facilities, and novel services to conduct advanced fish research.

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Welcome from the AQUAEXCEL2020 Coordinator

Dr. Marc Vandeputte
AQUAEXCEL2020 coordinator, French National Institute for Agricultural Research (INRA)

AQUAEXCEL2020 is now on the way to complete its fourth year of operation, with excellent progress in all aspects. The Transnational Access (TNA) programme is highly successful, and more access capacities have been provided to some of the facilities that were in high demand. Although some facilities are closed for access now, many still offer great access opportunities. The 16th Call for Access is planned to open in late October 2019.

Innovation arises from the project's own research lines, with new devices such as the nano-sensor AE-FishBIT (see p.4) which allows for unprecedented monitoring of individual fish held in groups. More innovation from the project, including from TNA research, will be showcased at the industry brokerage event organized by EATiP and AquaTT within the framework of the Aquaculture Europe 2019 event in Berlin on October 9, 2019.

Thanks to a one-month extension granted by the European Commission, we will also be able to set up a final brokerage event at the Aquaculture Europe 2020 conference in Cork (Ireland) in October 2020.

All face-to-face **AQUAEXCEL2020** courses are now finished or fully booked, but some courses remain available online (see p.6). All courses have had a high demand, highlighting their relevance to the aquaculture sector.

The University of Las Palmas de Gran Canaria will host our next annual meeting (29th to 31st October 2019), where we will plan the final year of the project.

I look forward to seeing more innovation, new results and happy TNA users to further highlight the relevance of **AQUAEXCEL2020** to the development of aquaculture R&D in Europe!

Marc Vandeputte

News and Highlights

Two more AQUAEXCEL2020 training courses successfully completed

AQUAEXCEL2020 aims to bring together, integrate, and open up highly diverse national and regional Research Infrastructures in Europe to all European aquaculture researchers, from both academia and industry, ensuring their optimal use and joint development. By 2020, **AQUAEXCEL2020** will have organised nine pioneering technical training courses in total, focusing on different aspects of aquaculture experimentation. **AQUAEXCEL2020** training courses aim to educate a new generation of aquaculture researchers and industry stakeholders to use their new knowledge, skills and tools in order to advance an innovative, sustainable aquaculture sector. These courses are divided into six face-to-face and three distance-learning courses.

Two successful face-to-face courses took place in early summer 2019; Recirculating Aquaculture System (RAS) Technology (May 2019) and Laboratory Animal Science for Aquatic Research Facilities (June 2019).

Recirculating Aquaculture System (RAS) Technology

The second **AQUAEXCEL2020** RAS Technology training course was hosted by Wageningen University (the Netherlands) with support from Ifremer (France), Nofima (Norway), NTNU (Norway) and DTU (Denmark), from 6th to 9th May 2019.

As part of this very popular course, leading experts in RAS technology presented the principles and concepts in RAS and discussed the operation of conventional and 'ecosystem approach'-based RAS. Participants gained an understanding

Participants networking after the mini industry seminar.
Photo by: Geertje Schlaman

News and Highlights Contd.

of the principles of recirculation technology, the types of RAS and their specificities, capabilities and limitations. Also covered were the advantages and necessary conditions for the optimal use / operation of RAS, and the ongoing research which can increase its efficiency and nutrient use.

A very successful mini industry seminar was also held, as part of the course, which attracted an attendance of 122 people. Organised in collaboration with NGvA (the Dutch association for aquaculture) and Aquarius (aquaculture student organisation), there were expert talks on the state of RAS in the world, requirements of Atlantic salmon smolts and post smolts in RAS, off-flavour and a talk by King Fish Zeeland on RAS in practice. King Fish is a marine aquaculture company producing Yellowtail in land-based recirculation systems, and is the world's first RAS fish farm to be awarded a Best Aquaculture Practices certification from the Global Aquaculture Alliance, a non-profit organisation dedicated to advocacy, education and leadership in responsible aquaculture. The seminar finished with social drinks and a business market by Aquarius. This gave participants the valuable opportunity to network with industry experts and discuss common practices and practical solutions to real life challenges in RAS farms.

The course included important and interesting technical visits. Participants visited the Aquaculture and Fisheries Group – Aquatic Research Facility (AFI-ARF) experimental facilities and a recirculating eel farm, for the opportunity to see the technology discussed during the lectures in action.

After the completion of their training, **AQUAEXCEL^{2020}** course participants were encouraged to complete an online survey to provide feedback. This feedback was very positive;

"The course was well organised, with clear topics and great trainers,"

"Even though I consider myself knowledgeable, the content and discussions encouraged me to think about the material and learn from new information."

"It was well organized, structured and conducted, focusing on important points and encouraging participants."

Laboratory Animal Science for Aquatic Research Facilities

Taking place in the Institute of Marine Research (IMR) facilities in Bergen, Norway from 17th to 21st June 2019, the second **AQUAEXCEL^{2020}** training course of the summer was organised by IMR (Norway), with the assistance and expertise of Nofima (Norway), Université de Lorraine (UL) (France), Wageningen University & Research (WUR) (the Netherlands), Norwegian University of Science and Technology (NTNU) (Norway) and the Norwegian Food Safety Agency (NFSA) (Norway).

The training course was designed to give participants an insight into the current European legislation around animal science in research, and the ethical requirements to be considered when working with animals in aquatic research facilities.

Participants of the Laboratory Animal Science for Aquatic Research Facilities training course in Norway. Photo provided by course tutor Tom Hansen.

Lecturers presented to the students on topics including larval quality in relation to welfare, cell lines and primary cell cultures, pros and cons in stress trial setups and minimum disturbance at sampling, transfer protocols for optimal welfare and performance in Atlantic salmon, experimental design and power analysis, tank size and fish management history in experimental design matters, and welfare, stress and pain. The training course also featured a field visit to Austevoll research station and IMR Matre.

As with the RAS training, participants were encouraged to complete an online survey to provide feedback. Again, very good feedback was received;

"Great course. Thanks to AQUAEXCEL^{2020} and IMR Bergen, Norway for a wonderful and great training. I was fascinated by Norwegian technologies which are used in aquaculture research. Presenters kept the course lively and gave a great effort to give lots of information."

"The field trips – the facilities available for your researchers were spectacular. The trips gave insight into how aquaculture research should be performed. Highly impressed!"

"An excellent general course where all the aspect regarding culturing fishes for experimental purposes are studied."

AE-FishBIT

The 2nd **AQUAEXCEL2020** newsletter (March 2017) contained a very interesting interview with Dr. Jaume Pérez-Sánchez from the Institute of Aquaculture Torre de la Sal (IATS-CSIC) in Spain. Jaume is one of the team behind AE-FishBIT - implanted biosensors for remote monitoring of the overall performance of fish. AE-FishBIT has had some exciting developments over the past 2 and a half years. Read on to find out more!

AE-FishBIT Moves Forward

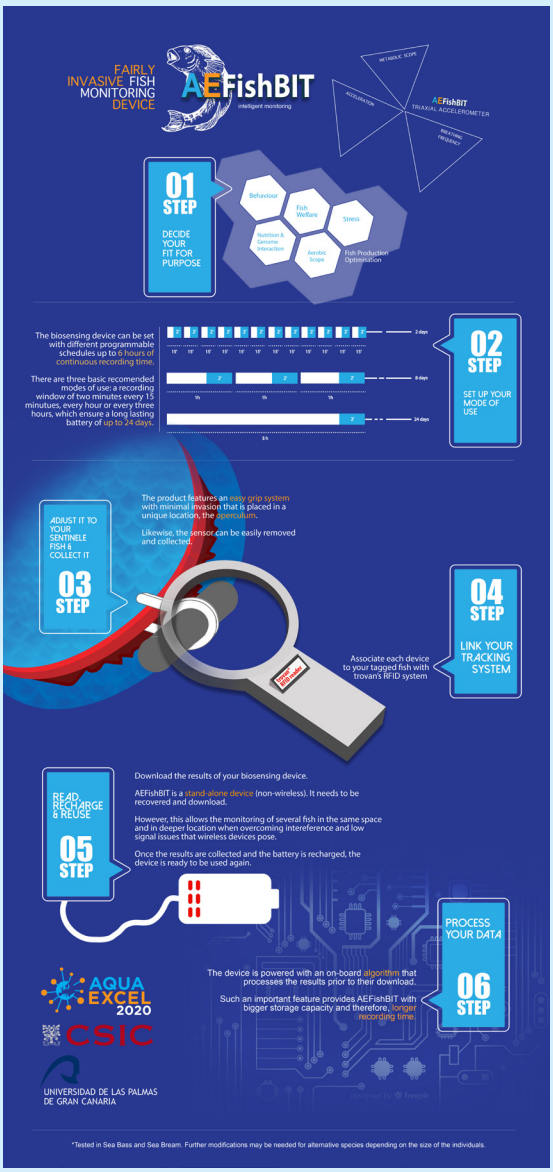
In May 2019, AE-FishBIT's design and functional validation was reported in an Open Access publication (Martos-Sitcha et al., Frontiers in Physiology 10:667, 2019, DOI: 10.3389/fphys.2019.00667). This smart device for tracking farmed fish behaviour is the result of collaborative work among biologists, engineers and bioinformaticians from two institutes of CSIC (IATS, IMB-CNM) and three institutes of the University of Las Palmas de Gran Canaria (IU-ECOAQUA, IUMA, IDeTIC) in collaboration with CCMAR (Centro de Ciências do Mar do Algarve, Portugal).

AE-FishBIT is a tiny and light device (less than one gram) composed of a tri-axial accelerometer, a microprocessor, a battery and a RFID tagging system for quick-smart individual identification. The device is designed to be attached to the fish operculum to monitor physical activity by mapping acceleration variations in x- and y-axes, while records of operculum beats (z-axis) serve as a measurement of respiratory frequency.

The initial functional validation with gilthead sea bream and European sea bass juveniles in swimming test chambers, highlighted the high correlation of oxygen consumption and fish activity with the calculated AE-FishBIT records. Further AE-FishBIT studies with free-swimming sea bream and sea bass in rearing tanks show that age, photoperiod, space availability or progression of disease outcome in parasitized fish alter diurnal/nocturnal activity. AE-FishBIT is also able to discriminate reactive and proactive fish when animals are challenged with low oxygen concentrations. Current experiments are focused on the effects of functional feeds in fish behaviour and its synchronizing with the environment.

Functional sea bream and sea bass tests, conducted at the Institute of Aquaculture Torre de la Sal (IATS-CSIC) and ULPGC (IU-ECOAQUA), are part of the work of WP8: Implanted biosensors for remote fish monitoring. The current work of this WP also involves other partners in the project (INRA, WU, NOFIMA, IMR) to focus their efforts on the attachment procedures and the functional validation in other fish species (rainbow trout and Atlantic salmon).

Main features and operational use are shown in the video available at **https://vimeo.com/325943543**. The video is aimed at the general public and also at aquaculture enterprises interested in the patented device for selective breeding and welfare assessment of their farmed stocks.



Step by step demonstration of the use of AE-FishBIT

In October 2019, the main achievements of using AE-FishBIT as a new tool for individual monitoring of metabolic traits in farmed fish will be presented in the **AQUAEXCEL2020** Brokerage Event taking place at Aquaculture Europe 2019 in Berlin.

For more information contact WP8 leader Jaume Pérez-Sánchez **(jaime.perez.sanchez@csic.es)**

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Past Events

IRAP meeting – April 2019 in Paris, France

It is expected that during its lifetime **AQUAEXCEL²⁰²⁰** will produce numerous outputs that are relevant to the European aquaculture industry in particular. **AQUAEXCEL²⁰²⁰** has a dedicated advisory body (the Industry and Research Advisory Panel (IRAP)), consisting of external representatives of the European aquaculture industry, which helps the project to translate this new, innovative knowledge into practice.

The 4th meeting of the IRAP took place in Paris on the 26th of April 2019. Members focused on the new Knowledge Outputs from the project and the Outputs which are deemed to likely have potential high impact on the aquaculture industry at present were identified and discussed. One such example is the AE-FishBIT as a new tool for individual monitoring of metabolic traits in farmed fish, see article above. In addition, this meeting gave IRAP members the opportunity to prioritise research areas for forthcoming Transnational Access (TNA) calls under the **AQUAEXCEL²⁰²⁰** project, based on current industry needs recommendations. Based on the outcomes of the meeting, the next industry brokerage event where the newest high potential Outputs will be presented to the industry will take place at Aquaculture Europe 2019 in Berlin (EATiP session: 9 October 2019). See upcoming events below.

Members of the IRAP committee in Paris, April 2019. Photo by Marieke Reuver

Upcoming Events

AQUAEXCEL²⁰²⁰ Industry Brokerage Event 2019 – October 2019 in Berlin, Germany

Would you like to hear about the latest innovative research findings which can be applied to the aquaculture industry? Would you like to contribute to the discussion on what industry expects from aquaculture research? You have the unique opportunity to do so at the next **AQUAEXCEL²⁰²⁰** industry brokerage event, which will be held in Berlin at Aquaculture Europe 2019 on the 9th October 2019! **AQUAEXCEL²⁰²⁰** industry brokerage events are aimed at creating a forum for engagement and exchange between researchers and potential beneficiaries of the research results, in particular industry stakeholders.

The Aquaculture Europe 2019 event will take place from 7 – 10 October at the Estrel Congress Centre, Berlin. Representatives from **AQUAEXCEL²⁰²⁰** will also have stands in the exhibition area to raise awareness of the project, its partnership and results, and to communicate with industry (say hello at stand 33 (AquaTT) and stand 149 (EATiP)).

For more information on Aquaculture Europe 2019 visit: **https://www.aquaeas.eu/uncategorised/402-welcome-to-aquaculture-europe-2019** and keep an eye on the **AQUAEXCEL²⁰²⁰** website and twitter account for further details on the industry brokerage day.

Partner Meeting – October 2019 in Gran Canaria, Spain

The 2019 **AQUAEXCEL²⁰²⁰** annual partner meeting will take place at La Universidad de Las Palmas de Gran Canaria (ULPGC) from 29th to 31st October 2019.

The timing of the meeting marks an important milestone given that the project will be completed within one year of the meeting date. **AQUAEXCEL²⁰²⁰** partners will discuss the progress of the project to date and agree on the organisation and coordination of the project over the final year. There will be plenty of exciting updates from the various **AQUAEXCEL²⁰²⁰** work packages.

The meeting will also offer attendees the opportunity to take a tour of ULPGC's experimental facilities.

Photo from Universidad de Las Palmas de Gran Canaria

Current AQUAEXCEL^{2020} Training Courses

AQUAEXCEL^{2020} training courses aim to educate a new generation of aquaculture researchers and industry stakeholders to develop new knowledge, skills and tools to advance innovation and sustainability in aquaculture. In total, nine state-of-the-art online and face-to-face training courses are being offered between April 2016 and September 2020.

All face-to-face training courses have now either taken place or have closed for registration. There are three free ongoing **AQUAEXCEL^{2020}** distance learning courses OPEN for registration. These courses allow for remote learning without the need to travel.

For more information please visit: https://aquaexcel2020.eu/training-courses/upcoming-training-courses-apply-now

USING MODELLING OF SCALE EFFECTS AS A TOOL FOR EXPERIMENTAL DESIGN COURSE

PROVIDER: SINTEF Ocean AS (SINTEF)

FORMAT: Online, recorded lectures

DATE: Live element completed with all materials available online

EXPERIMENTAL DATA MANAGEMENT: FROM GENERATING PROTOCOLS TO SHARING DATA COURSE

PROVIDER: University of South Bohemia in České Budějovice

FORMAT: Online, recorded lectures

DATE: Live element completed with all materials available online

TRAINING IN THE USE OF THE FISH AND CHIPS TOOL COURSE

PROVIDER: Institut National de la Recherche Agronomique (INRA)

FORMAT: Online

DATE: All materials will be available online from September 2019.

Please support the promotion of the important activities of the AQUAEXCEL^{2020} project, including the free training courses and TNA opportunities, by distributing this newsletter among your colleagues, organisations and wider networks.

Transnational Access (TNA)

TNA Program

A defining feature of **AQUAEXCEL^{2020}** is its TNA programme, allowing external teams to access the partners' infrastructures via submission of research proposals, which are funded based on the evaluation of an independent selection panel. Access is offered to 39 unique research infrastructures of participating institutes, with experimental costs, travel and subsistence supported by **AQUAEXCEL^{2020}.**

TNA – Calls for Access

AQUAEXCEL^{2020} calls for TNA are advertised on a regular basis. The final Calls for Access will take place over the coming months (see table 1). Applications are encouraged from aquaculture researchers (public and private), who wish to avail of facilities available at any of the participating 39 aquaculture research infrastructures associated with the project. Please note that as we are nearing the end of the project there are now less facilities available for TNA projects – please check with the contact person of your facility of choice for details. Potential applicants are encouraged to apply as soon as possible.

Table 1. Final calls for access:

Call no.	Activity	Date
16	opens	28 October 2019
	deadline	6 December 2019
17	opens	27 January 2020
	deadline	6 March 2020
18	opens	27 April 2020
	deadline	5 June 2020

For more information, see: **www.aquaexcel2020.eu**

TNA – Facilities under the Spotlight

TNA Facility: Consejo Superior de Investigaciones Científicas (CSIC): Instituto de Acuicultura de Torre de la Sal (IATS-EXP and IATS-ANA)

Location: Castellón, Spain

Website: www.iats.csic.es

Contact: Josep Calduch-Giner

Email: j.calduch@csic.es

The infrastructure offered by CSIC is made up of two types of installations (IATS-EXP and IATS-ANA) located in the campus of the Instituto de Acuicultura de Torre de la Sal (IATS) (Castellón, Spain) and a third installation located at the Instituto de Investigaciones Marinas (IIM) (Vigo, Spain). IATS and IIM offer the use of experimental tanks (EXP) and IATS also offers the use of analytical labs (ANA).

The Instituto de Acuicultura Torre de la Sal (IATS) is a public research centre of the state agency Consejo Superior de Investigaciones Científicas (Higher Council of Scientific Research) (CSIC), which has been active in the field of Marine Aquaculture since 1979. It is located in the region of Prat de Cabanes-Torreblanca Natural Park (Castellón, Spain) and often closely collaborates with other national and international entities.

The IATS-EXP facilities includes research holding tanks located in different units at IATS, with a total surface of 2,100m^2. There are approximately 250 tanks, with different shapes and capacities (from 30l to 3,000l), together with the associated wet labs and sampling rooms on offer for potential TNA projects. These installations are suitable for conducting experiments in many of the disciplines involved in aquaculture research including fish pathology (parasite and bacteria challenges), physiology, reproduction, nutrition and growth, live prey and larval rearing. Water quality (salinity, temperature, filtration, etc.) and light quality (photoperiod, intensity, etc.) vary depending on the type of projects and specific tanks in use. The open sea flow provides 90,000 m^3/h and water temperature ranges naturally from 11 to 28ºC. Tanks with recirculation and heat/cooling systems are available in some units. Experimental studies can be conducted with a great variety of species, such as gilthead sea bream, European sea bass, sole, turbot and Artemia. This includes access to one of the largest Artemia Cysts collections available in Europe.

Successful **AQUAEXCEL^{2020}** TNA applicants will receive access to all necessary live animals, equipment and consumables to complete their research project, as agreed in their project proposal. In addition, users will be provided with any necessary technical assistance, training and advice on methodologies, experimental design and data analysis. Users will be integrated in a research group and expected to collaborate in all the research processes including report and article writing and publishing. The visiting scientist will receive a workplace including internet access, and receive support in finding accommodation.

Catarina Moreira, a PhD student from Normandy University, France used IATS-CSIC facilities in her Transnational Access (TNA) research project. Her study entitled "Effects of Xenoestrogen exposure during immune system ontogenesis of the European sea bass, *Dicentrarchus labrax*" is a collaborative

View of the 4 buildings (A-D) which compose installation IATS-EXP within the campus of the Instituto de Acuicultura Torre de la Sal.

and multidisciplinary work involving several research groups from IATS (Fish Pathology group and Live preys in aquaculture, larviculture and ecotoxicology group), Centro de s. Ciências do Mar, Universidade do Algarve (Portugal) and the Department of Microbiology and Ecology, University of Valencia (Spain). This proved a challenging TNA project, since it involved the use of different IATS units and required fish being reared from very early stages until they reached the adequate size for the bacterial challenge. However, it was also a great opportunity for collaboration between the groups with expertise available including pathology, microbiology, immunology, toxicology, ontogeny, etc. For more information on Catarina's study please visit: **https://aquaexcel2020.eu/transnational-access/tna-projects**

For more information on the TNA programme and facilities please visit: **http://www.aquaexcel2020.eu/transnational-access/research-infrastructures.**

Please see **page 6** for upcoming TNA access application dates.

Fish 'n' Co.

Turbot – *Psetta maxima*

Turbot is part of the Scophthalmidae family – a family of flatfish. The turbot is found living in sandy and muddy substrates from shallow waters to 100 metres deep around the Atlantic coasts of Europe, and imitates the colour of the substrate where it is located. It is less frequently found in the Mediterranean.

Turbot spawns from May to July in the Atlantic and earlier, from February to April, in the Mediterranean. Larvae begin their lives with one eye on either side of the head but after 40 to 50 days of development the right eye moves to the left side. It has scaleless skin with an irregular distribution of bony protuberances.

It is a carnivorous species, with juveniles feeding on molluscs and crustaceans while the adults feed mainly on fish and cephalopods.

Turbot: By I, Luc Viatour, CC BY-SA 3.0.

The UK began farming turbot in the 1970s. It was then further developed in France and Spain. Although other EU countries are involved in turbot aquaculture activities, Spain, particularly the Galicia region, has become the main EU producer. A sizeable development of turbot aquaculture in Portugal is also expected. Other producers of turbot include Denmark, Germany, Iceland, Ireland, Italy, Norway, Wales, and previously the Netherlands. The natural distribution of the turbot includes coastal waters of all these countries. Turbot has also been introduced to other regions (notably Chile in the late 1980s) and, more recently, China.

Skilled staff working in technologically sophisticated hatcheries produce turbot juveniles. Reproduction in captivity is carried out under strictly controlled conditions. Broodstock are maintained in concrete tanks, at low densities, under specific photoperiod and temperature conditions, and fed on specially designed moist pellets. This provides eggs all year round. The eggs are pelagic and are placed in incubation tanks until hatching. When their mouths open, they are fed zooplankton and subsequently artemia (a small crustacean). Phytoplankton may also be added to the tanks. During their second month they are weaned onto commercial artificial diets. In the following two months, the juveniles are fed on dry granules in nurseries and reach a weight of 5-10 g. The juveniles are then transferred outside to bigger tanks for a pre-fattening period of several months until they reach around 100 g. On-growing normally takes place in outdoor, land-based, square or circular tanks with open-circuit pumped seawater. The tanks are covered to protect the fish from sunburn. Only a small proportion of European turbot is produced in recirculation aquaculture systems (RAS). Flat-bottomed cages can also be used for the on-growing stage but are less frequent. It takes 26 to 30 months to reach a commercial size of 1.5 or 2 kg. Source: **https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/turbot_en.pdf**

Turbot is generally sold whole, mainly to the restaurant trade.

The farming of turbot is renowned for its responsibility. Most companies have implemented ISP 14001, and some fulfil the EMAS II system of the EU. No impact on the environment has been detected in studies on the on-shore aquaculture of turbot. Source: **http://www.fao.org/fishery/culturedspecies/Psetta_maxima/en**

Sources:

European Commission - https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/turbot_en.pdf

FAO - http://www.fao.org/fishery/culturedspecies/Psetta_maxima/en

For updates on the **AQUAEXCEL²⁰²⁰** project, and aquaculture in general, follow us on Twitter:

@AQUAEXCEL2020

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Satisfy your Tastebuds!

Tasty Recipe – Pan fried turbot with crushed potato and champagne

© Ju Kim, as featured on RTE Lifestyle

INGREDIENTS (*serves 4*)

- 2 fillets of turbot
- handful spinach
- 30 g garden peas
- 300 g baby potatoes
- juice of 1 lemon
- 1 tbsp finely chopped parsley
- 200 ml champagne/prosecco
- 75 ml cream
- 40 g butter (in small cubes)

©Pelle Sten

Marc's Wine Tip: Champagne, of course!

PREPARATION

1. First, prepare the crushed potatoes. Scrub the potatoes, put them in a saucepan of cold water, add a good bit of salt, cover and bring to the boil. Leave to boil for 15 minutes and then drain.
2. Crush the potatoes with the underside of a fork until the skin splits and you are left with an assortment of different sized pieces. Dress the potatoes with the olive oil, the freshly squeezed lemon juice and parsley. Keep warm.
3. To make the champagne beurre blanc, start by placing the champagne in a saucepan and bringing to the boil. Lower heat and simmer the champagne to reduce by half.
4. Add in the cream and gently simmer for 5 minutes. Add in the butter cube by cube and stir to give the sauce a brilliant gleam.
5. To prepare the spinach and peas, place the spinach in a small frying pan with a little butter and allow the heat to wilt the spinach. Season with salt and pepper. The peas can be cooked in the same way.
6. Season the turbot fillets with salt and pepper. Heat some olive oil in a pan and add the fillets flesh side down and fry for two minutes.
7. Using a spatula, carefully flip over the fillets and fry with the skin side down for one minute.
8. Turn the fillets one more time onto the flesh side and add a knob of butter to give the fillets a beautiful golden colour.
9. Just before turning off the heat, squeeze the juice of half a lemon onto the fillets. Be sure to be leaning back slightly as the lemon juice may cause a flambé!
10. To serve, carefully pile the crushed potatoes using a chef's ring in the middle of a warmed plate.
11. Place a layer of the wilted spinach on the potatoes and then the turbot with the golden flesh side up. Scatter some peas around the potato, spinach and turbot tower.
12. Drizzle the champagne beurre blanc on the fish and around the tower.

© Ju Kim, as featured on RTE Lifestyle: https://www.rte.ie/lifestyle/recipes/2011/1005/746130-pan-fried-turbot-with-crushed-potato-and-champagne-beurre-blanc/

AQUAEXCEL2020 Recent Publications

Forner-Piquer, I., Mylonas C.C., Fakriadis, I., Papadaki, M., Piscitelli, F., Di Marzo, V., Calduch-Giner, J., Pérez-Sánchez, J., Carnevali, O. (2019). Effects of diisononyl phthalate (DiNP) on the endocannabinoid and reproductive systems of male gilthead sea bream (Sparus aurata) during the spawning season. Archives of Toxicology. 93, 727-741. **DOI:10.1007/s00204-018-2378-6**

Martos-Sitcha, J.A., Sosa, J., Ramos-Valido, D., Bravo, F.J., Carmona-Duarte, C., Gomes, H.L., Calduch-Giner, J.À., Cabruja, E., Vega, A., Ferrer, M.Á., Lozano, M., Montiel-Nelson, J.A., Afonso, J.M., Pérez-Sánchez, J. (2019). Ultra-low power sensor devices for monitoring physical activity and respiratory frequency in farmed fish. Frontiers in Physiology. 10, 667. **DOI:10.3389/fphys.2019.00667**

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Saberioon, M., Císař, P., Labbé, L., Souček, P., Pelissier, P. and Kerneis, T. (2018). Comparative Performance Analysis of Support Vector Machine, Random Forest, Logistic Regression and k-Nearest Neighbours in Rainbow Trout (Oncorhynchus Mykiss) Classification Using Image-Based Features. Sensors, 18(4), p.1027. **DOI: 10.3390/s18041027**

Saberioon, M. and Císař, P. (2018). Automated within tank fish mass estimation using infrared reflection system. Computers and Electronics in Agriculture, 150, pp.484-492. **DOI: 10.1016/j.compag.2018.05.025**

Martos-Sitcha, J.A., Simó-Mirabet, P., de las Heras, V., Calduch-Giner, J.A., Pérez-Sánchez, J. (2019). Tissue-specific orchestration of gilthead sea bream resilience to hypoxia and high stocking density. Frontiers in Physiology, 10, pp.840. **DOI: 10.3389/fphys.2019.00840**

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