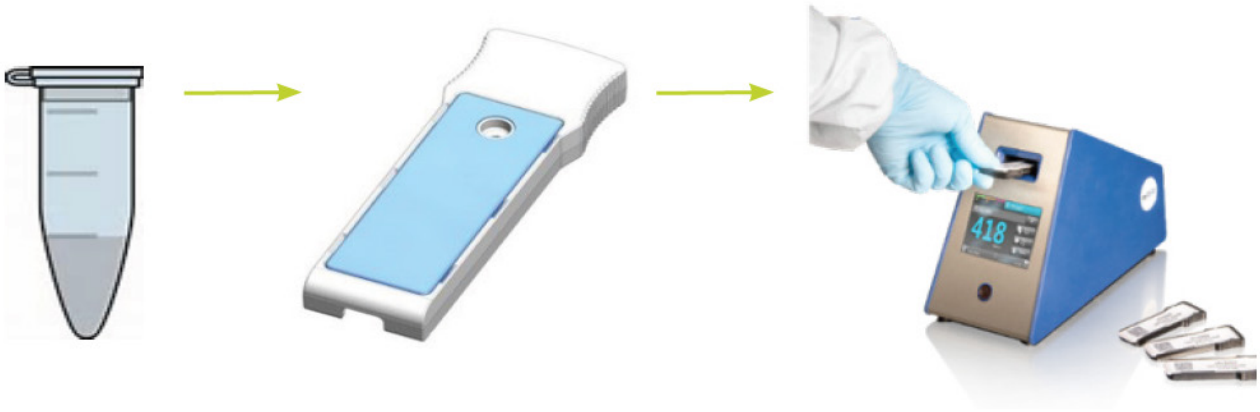
Rapid screening: Optical biochip for single- and multi- plex detection of regulated marine toxins in seafood

SEAFOOD TOMORROW
NUTRITIOUS, SAFE AND SUSTAINABLE SEAFOOD FOR CONSUMERS OF TOMORROW



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SUMMARY

Marine biotoxins and their toxin analogues are potent toxins naturally produced by algae which can accumulate in shellfish, and pose a serious human health risk if consumed. These include Saxitoxin (STX), Okadaic Acid (OA), Domoic Acid (DA), and Azaspiracid (AZA). Under EU Commission regulation 853/2004, maximum permitted toxin levels in shellfish for consumption have been established. Reference analysis techniques have been established, and are implemented by national programmes under EU legislation. This output concerns a new method to screen for regulated biotoxins, and Tetrodotoxin (not currently regulated), using a novel optical biochip based on an antibody immunological method. The method allows for quick, easy and reliable screening of toxins by industrial end-users, in the field and at production sites, and supports existing and future regulations that safeguard human health.

KNOWLEDGE NEED

Shellfish producers are under constant pressure from regulators and consumers to control the levels of regulated contaminants in their products. Complex analytical methods, sample preparation protocols, and data processing for each regulated compound are currently required for testing and screening. These methods require sophisticated laboratories and equipment, are costly and laborious to implement, and not suitable for industrial end-users. There is an urgent need to develop simple, specific, cost-effective and fast screening methods to detect and quantify marine toxins.

RESULTS

SEAFOODTOMORROW has established novel single- and multi- plex detection methods, using optical biochips, for regulated marine biotoxins of most concern. The methods build upon previous work on optical biochip technology, based on antibody microarray manufacturing and planar waveguide, for biotoxin detection. The simple, two-step extraction and detection procedures for each method can be carried out with minimum training. Users can prepare the shellfish sample extract using low-level technical laboratory equipment and apply the extract to the test cartridge, developed using highly sensitive antibodies and based on an immunological competition inhibition assay. The cartridge is then read on a low cost LightDeck® Diagnostics box which gives a specific light signal depending on if the target toxin is present or not. The analysis, which can be performed in 20 minutes, allows for the detection of multiple toxins, to concentrations less that 1ng/ml, meeting all global requirements. It has been validated for several shellfish species including mussel and oysters, with proven repeatability and reproducibility. The technology has been evaluated and proven fit for purpose for validation requirements. This method provides a novel method to guarantee shellfish safety and protect human health.

IMPACTS

This technology has significant potential to improve shellfish safety in Europe, supporting growth and profitability in the sector. The method would have significant impact on several levels: reduce produce loss, support toxin monitoring programmes, improve management strategies, and increase the availability of safer seafood on the market, improving consumer trust and seafood consumption habits and contributing to an improved health profile of the European population.

Contributes to the UN Sustainable Development Goal 12: Responsible consumption and production.

DISSEMINATION AND EXPLOITATION

Dissemination activities for scientific community:

- Scientific publication. *In preparation*
- Project newsletter and news articles
- Promotion on Twitter and LinkedIn

Exploitation activities for seafood industry:

- Marine Biotoxins Protocol - video and flyer (developed by Biorex Food Diagnostics): seafoodtomorrow.eu/media
- Demonstration of the strategy at **SEAFOOD**TOMORROW demonstration workshops, in France, and Spain (February – March 2021) to support uptake and use of the method.
- Horizon Results Platform: seafoodtomorrow.eu/horizon-results-platform

Exploitation activities for policy makers:

- Monitoring agencies, regulators and policy makers will be reached through the final **SEAFOOD**TOMORROW event, info session, and a dedicated EU policy event.

END-USERS & APPLICATIONS

Shellfish industry stakeholders along the supply chain: commercialisation of the optical biochip would allow broodstock suppliers, hatchery operators, farmers, harvesters, and wholesale distributors to apply this method and to ensure the production of safer shellfish, reduce losses and support greater economic activity.

Research and Development community: scientists, researchers and academics working in the fields of biotoxins, and shellfish safety can use this novel method and technology to support further Research and Development of tools to support the industry.

Regulators - EU food safety authorities and policy makers: new knowledge generated by this knowledge output can be used to support near-future EU regulation on marine toxins, including the approval of alternative reference analysis techniques, ensuring the production and sale of safer seafood.

INNOVATION STATUS

Singleplex assay: Technology Readiness Level 6 – technology has been validated and demonstrated

Multiplex assay: Technology Readiness Level 4 – technology has been validated in lab

Patents and IPR: The reader technology resides with Lightdeck® Diagnostics. The reagents, for further development of the system, can be provided under licence from QUB (see contact below).

FUTURE RESEARCH

The potential impacts must be showcased to attract investors to support further Research and Development. Further prototyping and full marketability for singleplex and multiplex use is needed. The next steps include discussing the use of this technology, to manufacture a solution for market, with companies such as Biorex Food Diagnostics. The market may require more toxins to be added to a multiplex device to cover emerging toxins and validation in an inter-laboratory ring trial. Further validation of different shellfish and seafood matrices may also be required. For the method to be adopted legally, more research at regulatory, semi-industrial and industrial levels is needed to verify the results. AOAC or NSSP validation and accreditation of the method would also support implementation.

CONTACT AND CONTRIBUTORS

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