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ALGADEC

Development of rRNA-Biosensors for the detection of Toxic Algae

The Challenge

Toxin-producing micro-algae have been responsible for public health, environmental, and economic episodes throughout history. These Harmful Algal Blooms (HABs) are known to have a wide range of negative health effects in humans. HABs are also responsible for the physical impairment of fish, fish kills and the degradation of habitats. The direct effects of toxic algae have significant economic impacts on fishing, fish farming and tourism. In the last decades proliferation of these toxin producing algae has increased as a result of human impact on the ecosystem. As yet, no cost effective device for the specific detection of toxic algal strains is available on the market.

Currently, coastal monitoring requires the transportation of samples to specialised laboratories where determination of toxic algae concentration is labour-intensive and expensive. Some microalgae may produce harmful toxic effects at concentrations of only a few cells per litre. The specific recognition of a poisonous strain is complicated as, in some cases, harmful and benign algal strains are morphologically identical with differences only apparent at a molecular level.

This time lag from receipt of samples to identification of species does not facilitate the main purpose of monitoring- which is taking preventive measures when coastal areas are threatened by HABs. Monitoring costs represent a major economic outlay for the European industry and there is a need to develop a tool for identifying Harmful Algal Blooms in order to limit their impact on fish farms.

Project Objective

The primary aims of 'ALGADEC' were to predict dangerous concentrations of algal cells by developing an automated, species specific and cost effective biological sensor for a rapid detection of toxic algae in situ. The development of this tool would improve current European monitoring systems and have the potential to mitigate economic losses in aquaculture and tourism. Ultimately, consumer confidence in aquaculture product safety would be enhanced.

Output Highlights

The ALGADEC project developed an automated biological sensor for rapid detection of toxic algae. The biological sensor is based on a multi probe chip that is capable of detecting rapidly and specifically the presence of harmful algae. It looks at short DNA sequences, which are highly species-specific and permit algal species identification following a hybridization step between a known DNA probe and total RNA extracted

EATiP *Thematic Area of Relevance*

TA1: Product Quality, Consumer Safety and Health
TA2: Technology and Systems
TA3: Managing the Biological Lifecycle
TA4: Sustainable Feed Production
TA5: Integration with the Environment
TA6: Knowledge Management
TA7: Aquatic Animal Health and Welfare
TA8: Socio-Economics and Management

Key Words

Harmful Algal Blooms (HABs), Monitoring, rapid detection, species specific detection, biochip, rRNA-sensor, DNA-analysis, detection of toxic algae, cost effective

Project Information

Contract number:
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no contract type
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SME-1 Co-operative Research (all areas of science and technology)
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29 months (15/07/2004 – 14/12/2006)
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from a natural phytoplankton population. **The biosensor developed in the ALGADEC project is the first device that allows aquatic farmers to check for the presence of toxic algae in their waters at an early stage and to take the proper measures to prevent contamination and the economic losses associated with it.** The ALGADEC biosensor is expected to contribute to a reduction in the health risk for humans who eat farmed fish and shellfish and even those who collect shellfish themselves - as warning notices not to collect can be posted earlier. Another field of application can be the monitoring of coastal swimming areas to prevent humans from damage to health.

Next Steps – Suggested Actions/Follow On

RTD

- The biosensor, developed in ALGADEC is a platform technology, with a detection principle that can be relatively easy transferred to other applications, such as microbial species in food production, medical diagnostics and environmental monitoring.
- The Helmholtz-University Young Investigators Group "PLANKTOSENS", located at the Alfred Wegener Institute for Polar- and Marine Research and the Jacobs University Bremen is currently studying the further development of the biosensor system for an automated observation of key marine phytoplankton species in the North Sea and Polar Regions. This involves the development of an automated sampling device and an automation of the sample preparation. New probe sets are also under development for the detection of diatoms. This project is supported by funds of the Helmholtz Association and the "COSYNA- Coastal Observing System for Northern and Arctic Seas", funded by the German government (BMBF).
- Another complementary project is developing the biosensor for the monitoring of toxic Cyanobacteria in the context of drinking water production. This project is also supported by the German government (BMWi).

Related Publications/Projects

Publications ALGADEC:

Articles:

1. Diercks, S., Metfies, K., Jäckel, S., Medlin, L. K.(2010).Development and optimization of a semi automated rRNA biosensor for the detection of toxic algae, Harmful Algae, in press
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3. Metfies, K., Diercks, S., Medlin, L.K.(2008).ALGADEC- Detection of toxic algae with a semi-automated nucleic acid biosensor, Coastal and Marine Wiki.{http://www.encora.eu/coastalwiki/Main_Page},http://www.encora.eu/coastalwiki/ALGADEC_-_Detection_of_toxic_algae_with_a_semi-automated_nucleic_acid_biosensor.
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6. Diercks, S., Metfies, K., Medlin, L. K.(2008). Development and adaptation of a multiprobe biosensor for the use in a semi-automated device for the detection of toxic algae, Biosensors & Bioelectronics, 23:1527-1533
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