VALIDATION

Enhance groundwater recharge under controlled conditions and/or modifying the landscape to intentionally release of certain compounds that subsequently cause oxidative stress response as a novel endpoint. This study demonstrates the usefulness of effect-based methods to identify samples where further chemical analyses are needed to reveal the identity of the compounds causing the measured effects.

BARRIERS AND SOLUTIONS

Typically, regulatory acceptance of emerging technologies is a slow process, and currently harmonisation of dental bonds with dental regulations is ongoing. The installation of Waternet were tested. The results show that environmental monitoring and validation studies are being carried out in an effort to bring bioassays under increased monitoring pathways. In addition to providing cost-effective means for safety demonstration and validation, bioassays hold the potential to serve as an additional, complementary technology for monitoring water quality.

Aquifer structures such as ponds, basins, and reservoirs that are used in aquifers. Various types of WWTP (ground, surface, and effluent water) are investigated as part of the DREAI project, were sampled in order to assess the potential of new commercially available technologies. Such thresholds serve to act as filters in identifying potential triggers.

Figure 1. 4th Edition of the Aquifer Workshop: Where the future is today?

Efficient monitoring and adequate treatment of water sources for potentially harmful emerging pollutants is essential for avoiding direct health risks to consumers. Therefore, regulatory acceptance of emerging technologies is an important goal for ensuring the public’s health and safety.

Figure 2. Crucial steps towards the better regulatory- and end-user acceptance of bioassays, as innovative tools for water quality monitoring.

Figure 3: Dr. Merijn Schriks
Figure 2 and 4: Dr. Eszter Simon

Image credits:

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Authors:


Recent advances in the design and implementation of bioassays for emerging pollutants have highlighted the potential of these techniques as regulatory tools. This paper reviews the current state of the art in bioassay development and application, with a particular focus on emerging pollutants in drinking water.

Figure 4. Summary activity profile of the tested water samples in the in vitro CALUX bioassay panel (on the left) and the modified profile (on the right) of the AREc32 bioassay.

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Figure 4. Summary activity profile of the tested water samples in the in vitro CALUX bioassay panel (on the left) and the modified profile (on the right) of the AREc32 bioassay.
**INTRODUCTION**

In light of the increasing number of chemicals entering water bodies, as well as advances in bioanalytical strategies, new technologies for improving and optimising conventional monitoring programs could potentially help to develop and assess the status and scope of water quality monitoring. Though targeted chemical analysis is routinely used to water-quality monitoring and well adapted in regulatory frameworks, its scope is restricted to a relatively small selection of compounds. Integration of (biomolecular) techniques, such as bioassays, into novel monitoring programmes presents an opportunity to measure the integrated (eco)toxicological effects of chemicals found in aquatic ecosystems and/or sources of drinking water—regardless of the structure, constitution and identity of such chemicals.

One of the aims of the DEMEAU project is to demonstrate effect-based monitoring strategies and the usability of measuring the integrated (eco)toxicological effects of chemicals. Bioassays follow relatively simple protocols and allow for a fast, high throughput screening of adverse effects that occur in water and/or the environment. As the biological response of different living organisms confronted with a novel chemical is diverse and can be used to sensitively test the toxicity of a chemical, bioassays predetermine the type of toxicant eventually identified.

When selecting the suitable assay panel for water quality monitoring, the following criteria should be taken into account: (1) availability of standard protocol, (2) support and services provided, (3) short/realistic analysis time; (4) measure of accuracy, reliability, reproducibility and specificity; (5) applicability to complex samples. The latter is especially important, as methods that are currently available in bioassays work best when performing routine analyses, but may fail when applied to complex environmental samples.

**BACKGROUND**

Bioassays cut-off the potential to effectively and (pre-)screen large numbers of pollutants, while also offering important complementary tools to use in combination with chemical analysis. General bioassays, in particular, allow the identification of the observed biological effects caused by environmental chemicals. The measures that contain these chemicals. In recent years, bioanalytical techniques have developed so quickly that in vitro bioassays to effectively measure a wide range of major classes of toxicants in aquatic and non-aquatic toxic compounds, and the entire range of substances (androgenic and anti-androgenic agents) in the water cycle. Bioassays utilise living cells, plants or animals (in vivo) to determine the biological activity of a substance or environmental sample by comparing mixed-behavior of known and unknown substances.

**CONTAMINANTS**

These modern bioassays are capable of effect monitoring of a broad range of chemicals containing the following toxic endpoints relevant to assessment of aquatic environment. These contaminants include polycyclic aromatic hydrocarbons, polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF), and other hydroxy, ketonic, perfluorinated, and banned substances. The major advantages of the application of novel quantitative bioassays include the following:

- Improved safety assessment through measurement of the effects of untargeted (unknown) contaminants, indicating that are the result of metal-to-metal concentrations (ng/L).

**BIOASSAYS IN PRACTICE**

**Cost-effectiveness: simple and rapid assessment of the safety of water samples**

High-throughput screening capacity. Bioassays follow relatively simple protocols and allow for a fast, high throughput screening of adverse effects that occur in water and the environment. As the biological response of different living organisms confronted with a novel chemical is diverse and can be used to sensitively test the toxicity of a chemical, bioassays predetermine the type of toxicant eventually identified.

**In order to perform rapid and cost-effective water quality assessment, the high throughput (HTP) testing capacity of the assays is very important. Using robotic, automated sample manipulation, microplate-based assay formats, liquid-handling devices, sensitive detection, high-speed data readout, data processing and control software facilitates, the generation of large number of individual assay data points allow for more efficient screening, while also reducing the costs associated with chemical analysis. However, HTP screening is only applicable/cost-effective in laboratories with a high-throughput (HTP) screening capacity**.

**Figure 1. Generic workflow of water bioscreening**

**Figure 2. Workflow of a bioassay analysis**

In order to avoid possible contamination and loss of And the concentrations of the effect(s) of untargeted (unknown) water contaminants, including indicators that are the result of metal-to-metal concentrations (ng/L), concentrations of the selection of the appropriate protocol, in addition to the sensitivity of the applied extraction/concentration method, in addition to the sensitivity of the applied extraction/concentration method. The CALUX reporter gene assay (as well as the responses) are performed in an aqueous cell culture medium. In addition, the water samples directly to the cells, thus, far, appears to work, however, special care must be taken to avoid necrosis and/or bacterial contamination. In addition, the sensitivity of the assay is of much higher importance. This method is selected.

**Impact**

Bioassays provide the unique possibility to investigate water quality and/or specific endpoints based on the toxic activity of the pollutants that are present, as opposed to their specific structural nature. Bioassays are one clear step in the scope of water quality monitoring, and can be tailored and adapted for testing a range of water sources from general toxicology tests to very specific biological activities.

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**Potential users of the technology and applications include the following:**

- No-use of experimental animals, and
- Relating to human toxicity, if a human cell-based assay is applied, the in vitro readouts can help to well the cell types and extrapolate to the target organ. In addition, the derived toxicological dataset can be used for regulatory purposes (Van der Linden et al., 2008; Van der Burg et al., 2019).

**Potential users for applications for:**

- Improved safety assessment through measurement of the effects of unknown chemicals, facilitating the testing of known chemicals.
- Determination of the efficacy of pollution control measures.
- Defining and standardising the interpretation of results gained within monitoring studies using bioassays.
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