Effect-directed toxicity assessment of fractionated sediments from Bergen harbor (Norway) using receptor-based luciferase bioassays

[1]Rune Storli, [1]Odd André Karlsen, [2]Bjørn Einar Grøsvik, [2]Aasim Ali, [1]Anders Goksøyr.
[1]Department of Biological Sciences, University of Bergen, Norway
[2]Institute of Marine Research, Norway

Rune Storli
University of Bergen
Runestorli96@gmail.com

Figure 1: Vågen in Bergen, Norway where the sediment samples were collected
Picture: NTB/Scanpix

Figure 2: The location of Vågen in the center of Bergen, Norway
Picture: Google maps

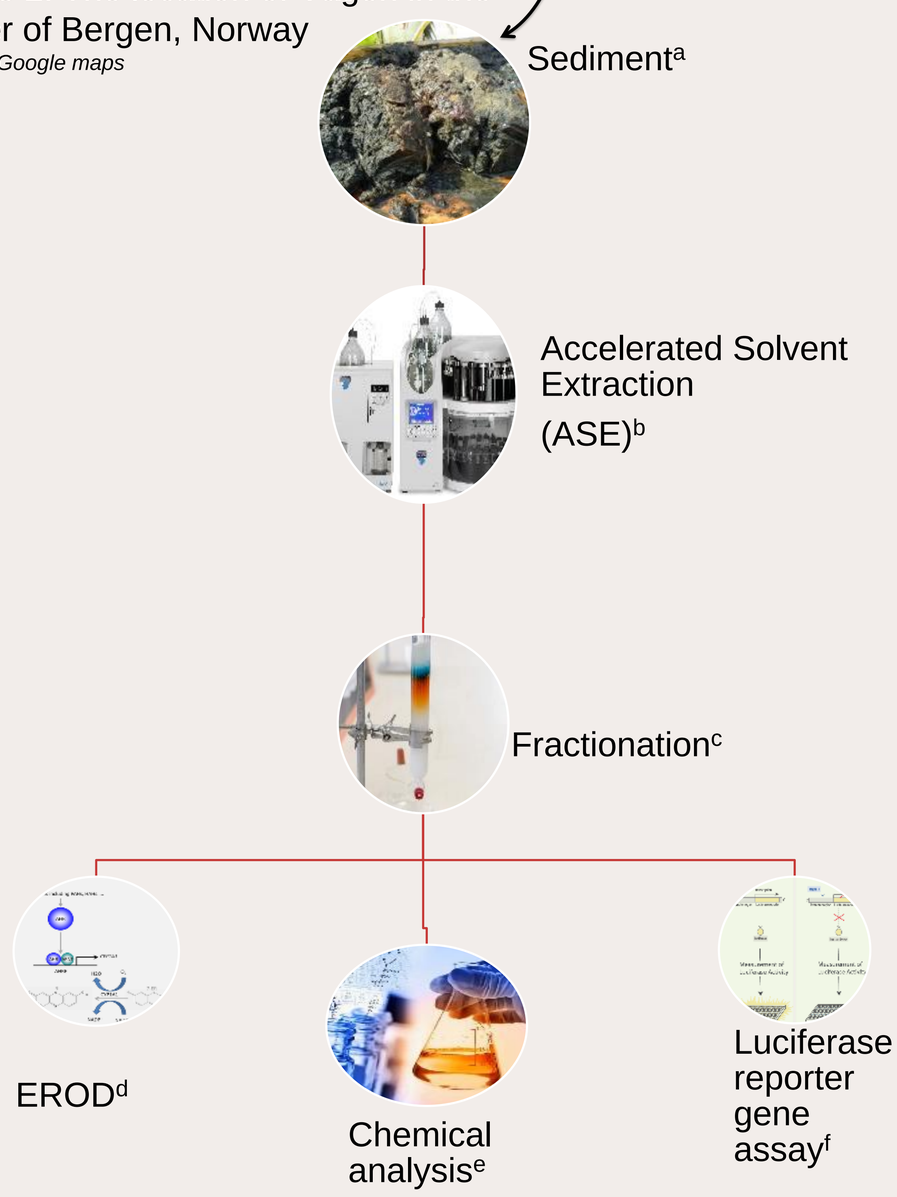

Figure 3: Flowchart of the methods used in this study

Vågen is a highly polluted part of the inner harbour of Bergen city[1]. Using cell-based bioassays, we have previously shown that sediment extracts from this part (1) contain high PAH and POP levels, (2) can activate cod Ahr receptors, but (3) at the same time show low ethoxyresorufin-O-deethylase (EROD) inducing capacity[1]. Here, we used effect-directed analysis (EDA) to further understand the complex toxicity of this polluted site.

1 Introduction

Determining which pollutants and toxicants that cause harm in complex environmental samples is a challenging task where EDA can be of great help. EDA is the structural identification of bioactive chemicals and the assessment of their contribution to overall endpoint-specific activity[2].

The receptors used in this study, Atlantic cod aryl hydrocarbon receptor (gmAhr2a), estrogen receptor alpha (gmEra), androgen receptor alpha (gmAra) and zebrafish pregnane X receptor (zfPxr) can indicate both toxicity and endocrine-disrupting activity as they are activated by a wide range of compounds like PAH, estrogen- and androgen mimicking compounds, BPAs, and PCBs, among others[1].

In this study, chemical fractionation, luciferase reporter gene assays, EROD assays, and chemical analysis has been employed to separate the different pollutants in the sediment extracts to provide a better understanding of the cause of the toxicity.

2 Methods

- Sediment sample collected from Vågen (Bergen)
- Pollutants extracted using Accelerated Solvent Extraction (ASE) and fractionated using gravity chromatography (GC) and redissolved in DMSO
- Receptor-based luciferase-assays employing gmAhr2a, gmEra, gmAra, and zfPxr in COS-7 cells were used to test agonistic activity of serially diluted extracts
- EROD assays were performed on the same fractions in PLHC-1 cells
- Chemical analysis is being performed for PFAS, PAHs, selected plastic additives and nontarget screening

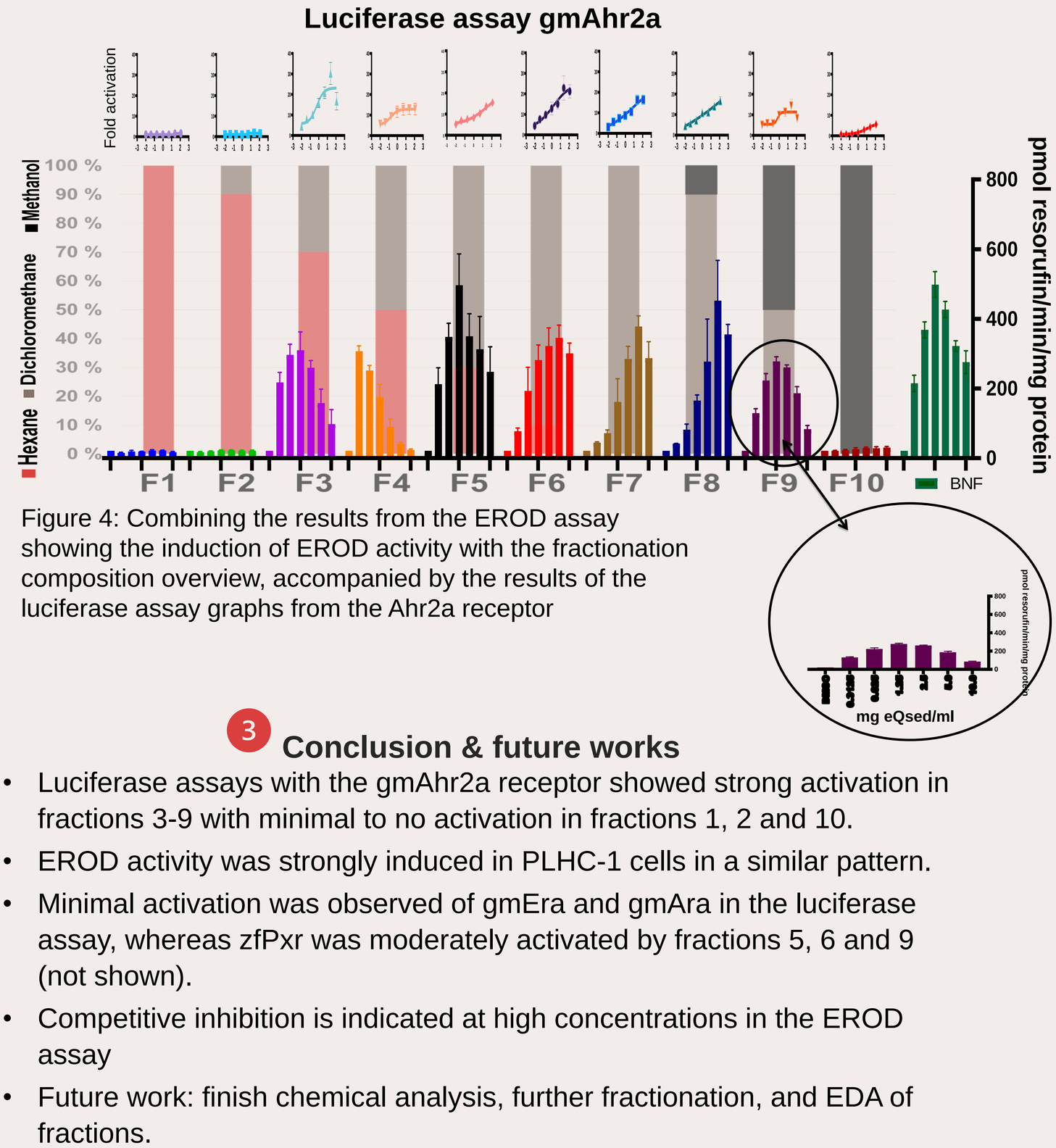

Figure 4: Combining the results from the EROD assay showing the induction of EROD activity with the fractionation composition overview, accompanied by the results of the luciferase assay graphs from the Ahr2a receptor

3 Conclusion & future works

- Luciferase assays with the gmAhr2a receptor showed strong activation in fractions 3-9 with minimal to no activation in fractions 1, 2 and 10.
- EROD activity was strongly induced in PLHC-1 cells in a similar pattern.
- Minimal activation was observed of gmEra and gmAra in the luciferase assay, whereas zfPxr was moderately activated by fractions 5, 6 and 9 (not shown).
- Competitive inhibition is indicated at high concentrations in the EROD assay
- Future work: finish chemical analysis, further fractionation, and EDA of fractions.

REFERENCES

Goksøyr, S. Ø. *et al.* (2021) 'Toxicity assessment of urban marine sediments from Western Norway using a battery of stress-activated receptors and cell-based bioassays from fish', *Environmental Toxicology and Pharmacology*, 87, p. 103704. doi: 10.1016/J.ETAP.2021.103704. [1]

Brack, W. *et al.* (2016) 'Effect-directed analysis supporting monitoring of aquatic environments — An in-depth overview', *Science of The Total Environment*, 544, pp. 1073–1118. doi: 10.1016/J.SCITOTENV.2015.11.102.[2]

ACKNOWLEDGEMENTS

This MSc study was funded as a part of dCod 1.0 project of the Research Council of Norway.

Thanks to Miljøringen for the funding to attend the PRIMO21 confrence

Image sources

Miljødirektoratet, 2022[a], ThermoFisher, 2022[b], Thongdumhyu/Shutterstock, 2022[c], Mohammadi-Bardbori and Mohammadi-Bardbori, 2014[d], Eurolab, 2022[e] , Tyasning, 2022[f]

UNIVERSITETET I BERGEN