

Thesis

Title of project / Master's thesis	Identification and quantification of estrogenic activity in freshwater samples: Development of a web-based application
Track	Special Track
Topic / Key words	Estrogenic activity, novel bioassay, image analysis, algorithm development, process chain development
Supervisor	Andreas Schönborn
Co-Supervisor	Ivo Kaelin
External partner	Planar4 GmbH Stäfa
Place(s) of work	Wädenswil

Abstract

Estrogenic activity in the environment is considered a matter of concern. Fish fertility, for example, can be impaired by the contact with estrogenic substances in wastewater. It is suspected that the decline of sperm counts in men may also be connected to the increasing estrogenicity in our human environment (i.e. in drinking water, food packaging, materials in furniture in apartments or offices).

Since the responsible substances are often unknown and sometimes active in extremely low concentrations, their chemical analysis is complicated and expensive. The planar bioassay concept is an innovative approach based on the combination of thin-layer chromatography with cell systems that allow to detect biological activity in very low concentrations (pg/l range). In the case of the planar-YES, the targeted effect is estrogenicity.

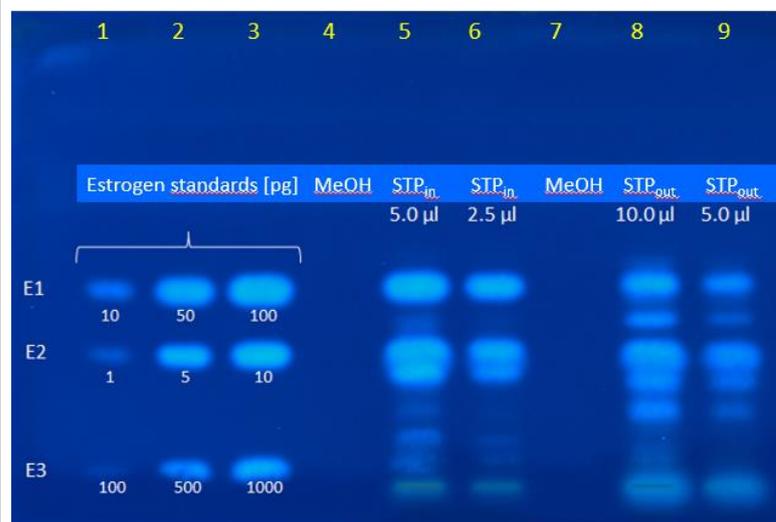


Fig. 1: Typical patterns of estrogenic activity in wastewater samples of a wastewater treatment plant inlet (tracks 5+6) and – outlet (tracks 8+9). Standard substances: tracks 1-3. Blanks: tracks 4 and 7.

The planar-YES bioassay uses a thin-layer chromatography (TLC) step to pre-separate unknown samples and a bioassay to detect estrogenic activity in them. It is used for various types of samples, e.g., drinking water, wastewater or packaging migrates. Fig. 1 shows the example of the in- and outlet of a German wastewater treatment plant. The planar-YES also allows the profiling/fingerprinting of estrogenic activity in samples, which offers a

Thesis

forensic aspect. Known substances can also be determined based on their polarity (Rf-value).

In this thesis the aim is to develop a web-based program (e.g., an app) that allows the evaluation of images taken from the TLC plates, processing, quantification and storage. Critical issues are:

- Image import from a camera or database
- (Automated) baseline correction
- (Automated) peak identification based on algorithms
- Calibration using standard estrogen zones
- Quantification of estrogenic activity
- Data collection and handling
- Half-automated evaluation of "fingerprints" (profiles) found in wastewater samples
- Data storage
- Integration of the above mentioned elements into a work-chain

If time allows, the program can be integrated into a new analytical device that is currently being developed.

The program may build upon a prototype developed in spring 2017, based on Python.

Requirements	<ul style="list-style-type: none"> - Interest in the issue of estrogens in the environment - Some background in programming (preferably web-based) & databases
Comments	The Forschungsgruppe Oekotechnologie has been co-developing the planar-YES bioassay since 2011. A spin-off company of ZHAW, planar4 GmbH, was founded in late 2017 and aims to bring the process to the market.
Date of document	15.4.2019
Contact	Andreas Schönborn, sand@zhaw.ch , 058-934 58 10