Group	**:** Organic Chemistry & Wageningen Food Safety Research
Project	**:** Towards portable mycotoxin detection by Selective Paper-Enhanced InfraRed Spectroscopy (S-PEIRS)
Supervisors	**:** Anouk Bosman (anouk.bosman@wur.nl), Gert Salentijn (gert.salentijn@wur.nl), Francesco Simone Ruggeri (simone.ruggeri@wur.nl)
Keywords	**:** Portable analytical chemistry, food contaminants, mycotoxins, paper-microfluidics, food safety, mid-infrared spectroscopy, screening, 3D printing, instrumental analysis

Introduction

The increasing demand for food and feed products is stretching the capacity of the food value chain to its limits. At the same time, a multitude of regulations are in place to ensure food safety and security for humans and animals. One of the most pressing food safety hazards are mycotoxins, which are secondary metabolites that are produced by toxigenic fungi, and are found throughout the entire food value chain. Mycotoxin analysis is typically performed by rather tedious and expensive chromatographic methods, such as liquid chromatography-tandem mass spectrometry (LC-MS/MS), for which expert operation is required. In addition, extensive sample preparation is required that is not easily carried out by non-experts at different points along the food supply chain. While such comprehensive confirmatory techniques are indispensable, simpler screening of mycotoxins is desired in order to relieve pressure from the laboratories.

To overcome such challenges, 3D-printed interconnectable modules for integrated, easy and on-site grinding and extraction prior to mycotoxin screening were developed[1]. For screening, IR spectroscopy is increasingly used to analyze a variety of food crops for quality and safety purposes in a rapid, label-free, and green manner[2]. However, the lack of sensitivity and the overlapping absorption characteristics of major sample matrix components such as proteins, lipids and carbohydrates prevent the direct determination of mycotoxins at relevant regulatory levels. Therefore, a novel method was developed which exploits paper-based microfluidics in combination with mid-infrared spectroscopy (MIR) for direct mycotoxin detection at the relevant levels, specifically deoxynivalenol (DON) in wheat.

In this project, specific mycotoxin enrichment through immuno- and/or chemical-based capture and release will be explored in order to purify a mycotoxin from a food commodity at relevant levels. Immunoaffinity columns (IAC), solid-phase extraction (SPE) and molecularly imprinted polymers (MIP) are some of the most used purification methods for analytes in complex (food) matrices. In addition, as on-site screening methods are designed to be simple, rapid and robust, the time-to-result is of the essence. The current work for the detection of deoxynivalenol in wheat will be diversified towards another potent mycotoxin that occurs in food and has adverse health effects, thereby you will contribute to develop a novel solution for on-site screening and ensure food safety.

Requirements

- Full-time available (start Sept 2024 or later)
- MSc thesis student

References

1: A.J. Bosman, S. Freitag, G.M.S. Ross, M. Sulyok, R. Krska, F.S. Ruggeri, G.IJ. Salentijn, *Interconnectable 3D-printed sample processing modules for portable mycotoxin screening of intact wheat*, Analytica Chimica Acta, 2024, https://doi.org/10.1016/j.aca.2023.342000

2: S. Freitag, M. Sulyok, N. Logan, C.T. Elliott, R. Krska, *The potential and applicability of infrared spectroscopic methods for the rapid screening and routine analysis of mycotoxins in food crops*, Comprehensive Reviews in Food Science and Food Safety, https://doi.org/10.1111/1541-4337.13054

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