

## PHD PROJECT DESCRIPTION

(4000 characters max., including the aims and work plan to be published online)

**Project title: The method development for the determination of per- and polyfluoroalkyl substances (PFAS) in biological samples using advanced spectroscopic techniques**

### 1.1. Project goals

The main goal of this project is to develop, optimize, and validate advanced analytical methods for the determination of per- and polyfluoroalkyl substances (PFAS) in human biological samples using mass spectrometry-based techniques, enabling reliable biomonitoring and exposure assessment.

### 1.2. Outline

Introduction and Scientific Background: characteristics, classification, and environmental persistence of PFAS; human exposure pathways and health relevance; role of biomonitoring in PFAS risk assessment

State of the Art in PFAS Analysis: overview of analytical techniques for PFAS determination; LC-MS/MS and SFC/MS as the targeted analytical standard; HRMS for suspect and nontarget screening; analytical challenges: contamination, matrix effects, limited standards

Materials and Methods: selection of target PFAS and biological matrices; sample collection and handling considerations; development and optimization of sample preparation procedures; optimization of chromatographic conditions for LC MS/MS and LC HRMS as well as SFC/MS; data processing and quality control strategies

Method Validation: validation parameters (selectivity, sensitivity, precision, accuracy)

Estimation of LODs and LOQs; matrix effect evaluation; reproducibility and robustness assessment

Application to Real Samples: analysis of selected biological samples; PFAS concentration profiles across matrices; comparative evaluation of targeted vs. nontarget results

Discussion: interpretation of analytical results; method performance in comparison to literature data; limitations and analytical uncertainties

Conclusions and Perspectives: summary of key findings; implications for PFAS biomonitoring; future research directions

### 1.3. Work plan

1. Comprehensive literature review on PFAS chemistry, toxicology, and analytical methods
2. Selection of target analytes and biological matrices
3. Establishment of contamination free laboratory practices
4. Preliminary optimization of sample preparation procedures
5. Development of targeted LC-MS/MS, SFC/MS analytical methods
6. Optimization of chromatographic and mass spectrometric parameters
7. Initial method validation (linearity, sensitivity, precision)
8. Full validation of LC-MS/MS and SFC/MS methods according to international guidelines
9. Implementation of HRMS based suspect and nontarget screening workflows
10. Analysis of selected real biological samples interpretation of targeted and nontarget results

#### 1.4. Literature (max. 7 listed as a suggestion for a PhD candidate preliminary study)

Buck, R. C., Franklin, J., Berger, U., Conder, J. M., Cousins, I. T., De Voogt, P., ... & Van Leeuwen, S. P. (2011). Perfluoroalkyl and polyfluoroalkyl substances in the environment: terminology, classification, and origins. *Integrated environmental assessment and management*, 7(4), 513-541.

Criswell, R. L., Wang, Y., Christensen, B., Botelho, J. C., Calafat, A. M., Peterson, L. A., ... & Romano, M. E. (2022). Concentrations of per-and polyfluoroalkyl substances in paired maternal plasma and human milk in the New Hampshire birth cohort. *Environmental Science & Technology*, 57, 463–472.

Chatziioannou, A.C. et al. (2025). Biomonitoring of endocrine disrupting chemicals including PFAS using chromatography and mass spectrometry. *Toxics*, 13(12), 1029.

Perera, D. et al. (2024). Techniques to characterize PFAS burden in biological samples: recent insights and remaining challenges. *Trends in Environmental Analytical Chemistry*, 41, e00224.

Strynar, M. et al. (2023). Practical application guide for the discovery of novel PFAS using high resolution mass spectrometry. *Journal of Exposure Science & Environmental Epidemiology*, 33, 575–588.

Dobrzyńska, E., Wasilewski, P., & Pośniak, M. (2025). Per-and Polyfluoroalkyl Substances (PFASs): a comprehensive review of environmental distribution, health impacts, and regulatory landscape. *Appl. Sci*, 15, 11884.

#### 1.5. Required initial knowledge and skills of the PhD candidate

- Skills in analytical chemistry, knowledge of chromatographic techniques (HPLC, LC-MS, TLC, TLC-MS) and extraction methods (i.e. SPE, MSPD, ASE, SFE).
- The ability to analytical thinking.
- The PhD candidate should have experience in laboratory work, planning experiments, performing qualitative and quantitative analysis and conducting method validation.
- Required initial knowledge and skills in ChemStation (Agilent), MassHanter (Agilent), Statistica.

### 1.6. Expected development of the PhD candidate's knowledge and skills

- The candidate will have the opportunity to develop new methods for the isolation and determination of analytes using HPLC in combination with various MS, detection systems.
- Broadening the knowledge and skills to the preparation of raw plant's material and biological samples.
- Broadening the specialized knowledge of plant biology and chemical sciences.
- Proposed studies provide the opportunity to acquire specialist knowledge in the field of analytical chemistry and statistical methods.
- Developing the ability to present posters and oral presentations at conferences. Also, the PhD student will be the author and co-author of publications quartile category Q1.
- The PhD student will have the opportunity to develop methodologies and procedures recommended for the routine food or pharmaceutical analysis.