



Antwerp, 19<sup>th</sup> June 2022

## Report on the Habilitation thesis presented by

**Darina DVORAKOVA**

Thesis title

### **BIOMONITORING: TOOL FOR THE ASSESSMENT OF HUMAN EXPOSURE TO ENVIRONMENTAL CONTAMINANTS**

#### **EVALUATOR:**

Academic Title:

Full Professor

Name and Surname:

Adrian Covaci

Field:

Environmental Chemistry and Toxicology

## **EVALUATION REPORT**

The research work presented by Dr Ing Darina DVORAKOVA was carried out during her post-doctoral (after 2017) and partly during the doctoral period (before 2017) until beginning 2022 at the University of Chemistry and Technology (UCT), Prague. She has a Bachelor degree in Food Chemistry and Analysis obtained in 2008, a Master degree in Food Quality and Safety, and PhD obtained in the Department of Food Analysis and Nutrition, all diplomas obtained at the Faculty of Food and Biochemical Technology, UCT, Prague, Czech Republic.

Currently, her tasks as researcher and Assistant Professor is the development of targeted methods for priority contaminants present in biological matrices. She brings to the team her expertise in analytical chemistry and in particular in trace analysis in complex biological matrices by advanced mass spectrometry techniques in relation to human biomonitoring programs.

Dr Darina DVORAKOVA presents in a systematic way her research activities that she has been carried out and participated to in the frame of several national and European projects. This choice in the presentation allowed her to find a coherence in the activities carried out these past years (2010-2022) and to highlight a major axis of her work centred on analytical chemistry applied to the analysis of chemical hazards at the trace level in complex human biological matrices. During this time, she has also been involved in activities concerning method validation, data interpretation, quality assurance and quality control, risk analysis, collaborative projects, and scientific communication.

The thesis is structured in a brief description of objectives (p11), a part introducing the human biological monitoring (HBM) (p13-18), followed by the description of general aspects and properties of the investigated environmental contaminants, such as PCBs, OCPs, BFRs, PFAS and metabolites of polycyclic aromatic hydrocarbons (PAHs), phthalates and di-iso-nonyl cyclohexane-1,2-dicarboxylate (DINCH), and the choices that guided the selection of the study molecules (p19-24). The various sample preparation strategies used in the analysis of biological matrices, serum, milk and urine (p25-30) are consequently presented and in particular, attention has been paid to possibility to combine determination of various groups of chemicals into one “multi-analytes” method, thus to decrease the requirements for the amount of biological material needed for their analysis. The application of these methods, together with the description and discussion related to various HBM studies is further developed (p31-36), followed by conclusions and future perspectives (p37-40).

Following topics have been addressed in the papers presented in this Habilitation thesis and are grouped in two large subjects: A) Analytical strategies and B) HBM applications.

#### **(A) DEVELOPMENT OF THE NOVEL ANALYTICAL STRATEGIES**

- Multi-analyte method for the analysis of five groups of POPs in human blood serum (**Appendix I**)
- Method for the simultaneous determination of PFAS, BFRs and their metabolites in human breast milk (**Appendix II**)
- Simple method for the analysis of phthalate and DINCH urinary metabolites (**Appendix III**)
- Novel strategy for the determination of HO-PAH metabolites in urine (**Appendix IV**)

#### **(B) HUMAN BIOLOGICAL MONITORING (HBM)**

- Introduction of the quality assurance/quality control programme for the analysis of selected priority chemicals within the European human biomonitoring platform (**Appendix V** and **Appendix VI**)
- Biomonitoring of POPs represented by FRs, PFAS, OCPs and PCBs in serum of Czech population (**Appendix I** and **Appendix VII**)
- Determination of PFAS in serum of mother-child cohort in the Slovak Republic (**Appendix VIII**)
- Analysis of PFAS in breast milk collected within Czech human biomonitoring program (**Appendix II** and **Appendix IX**)
- Occurrence of OH-PAHs (**Appendix X** and **Appendix XI**), metabolites of phthalates and DINCH (**Appendix III**) in urine of Czech mothers and their newborns



The Habilitation thesis of Dr Darina DVORAKOVA is well written and easy to follow; her role and contribution to the different projects are always informed, the objectives and goals are also clearly presented in the more global frame of the laboratory's intentions. This manner of presentation indicates a professional scientific maturity.

The research questions and solutions addressed here can be divided into three interconnected areas: (i) methodological topics (development of targeted methods, often including the handling of difficult analytical challenges) (ii) generation of prevalence data in human biological samples in the frame of HBM studies; (iii) setting up QA/QC programs, such as the HBM4EU QA/QC programme for FR biomarkers in serum and urine (2018-2020).

Such interdisciplinary collaborative approaches are essential for a complete interpretation of the data and to be able to draw adequate conclusions. In this context, Dr Darina DVORAKOVA was able to surround herself with appropriate and relevant partners, as shown by the large number of collaborative articles, whether national or European.

The spectrum of chemicals to be investigated in the future (e.g. in the context of the PARC EU project) will be broadened, to answer questions concerning the characterisation of human exposure to a wide spectrum of (re-)emerging and/or as yet unknown chemical hazards.

Dr Darina DVORAKOVA has to date 21 articles to her credit in international peer-reviewed journals. She also has 13 short papers (conference proceedings) and also presented in more than 100 contribution at scientific conferences both as oral presentations and posters

Some (non-exhaustive) suggestions on what can perhaps be developed further in Dr Darina Dvorakova's career are:

- More ambition to expand the HBM activities and in particular their interpretation into the wider scope of the human Exposome, in particular for specific populations
- More emphasis on the publication of a greater number of articles as 1<sup>st</sup> or last author
- Active participation as PI or co-PI in the securing of national/international research funds
- Active participation in the recruitment strategy of doctoral and Masters students (in terms of profiles and training). This activity which is very important in the context of academic with Prof. Dr. Habil title is poorly represented at present or at least not highlighted in the activities leading to this thesis.

To sum up, I consider the thesis submitted by Dr Darina DVORAKOVA for the Habilitation to perform and supervise research to be qualitatively and quantitatively very good. The achievements of the period encompassed by this Habilitation thesis are of a high level; this applies to the logic, depth and complexity of the work carried out, to the promotion of the research work in oral or written form, and finally to the ability to build and consolidate her own network in the Czech Republic and abroad to answer research questions at the interfaces.



In summary and in accordance with the assessment presented above, I am favourable to the defence of this thesis and ultimately confident in the ability of Dr Darina DVORAKOVA to obtain the Habilitation degree delivered by the University of Chemistry and Technology, Prague, Czech Republic.

Done in Antwerp, on 19<sup>th</sup> June 2022

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## QUALIFICATIONS OF THE EVALUATOR (Prof. Dr. Adrian Covaci)

Adrian Covaci is a Full Professor of Environmental Toxicology and Chemistry at the University of Antwerp (Belgium) and has broad expertise in the analysis and characterization of the occurrence, fate and resulting human exposure of a broad range of organic contaminants, including emerging contaminants, in human, environmental and food samples.

A particular focus of his research is on human exposure and risk assessment, with special attention paid to the role played by the indoor and outdoor environment. Recent research interests involve the characterization of human metabolism of new chemicals present in daily used consumer products using *in vitro* hepatic models and advanced mass spectrometric techniques. Also, human biomonitoring aspects and risk assessment of emerging organic contaminants are also of interest, together with the elucidation of exposure pathways to humans for organic contaminants.

As such, his research forms one of the major strands of activity within the wider Environmental Health Sciences research theme at University of Antwerp and it is part of the Excellence Centres "EnviroStress", "Enviromics" and "Exposome".

- Number of JCR articles on Web of Science (15 June 2022): 690
- Number of book chapters: 22
- h-index on Web of Science: 92
- Number of citations on Web of Science: <33,000
- Average citations per paper: 49.9

Complete list of articles @ <https://www.uantwerpen.be/en/staff/adrian-covaci/publications/>

- **co-Editor-in-Chief of Environment International** since 01/2016 (IF<sub>2021</sub>: 9.6; rank 7<sup>th</sup> out of 220 journals in Environmental Sciences)
- **Associate Editor of Science of the Total Environment** since 01/2012 (IF<sub>2021</sub>: 7.5; rank 28<sup>th</sup> out of 220 journals in Environmental Sciences)