Extraction, Detection, and Interpretation of PCB Congeners in Complex Matrices

The overall goal of the Analytical Core is to facilitate high-quality, high-impact research products in support of the University of Iowa Superfund Research Program (ISRP) such as data, methods, and peer-reviewed publications. The Analytical Core (AC) provides both routine and non-routine analytical services including expert staff, analytical methods, equipment, and instrumentation to enable research discoveries and fulfill the mission of the ISRP. Its Aims are:

Aim 1: Develop and maintain analytical and quality control/assurance standards and protocols, including quantification of PCB metabolites and breakdown products in environmental and laboratory matrices.

Aim 2: Perform high-throughput analysis of environmental and laboratory samples for a complete suite of PCB congeners in air, human blood serum, laboratory animals, building materials, and other complex matrices.

Aim 3: Develop innovative methods for interpreting complex signals from environmental samples.
Aim 4: Extraction, identification, and quantification of PCB decay products and metabolites.

Aim 5: Maintain the infrastructure for investigator support.

The Analytical Core provided facilities, expert labor, instrumental analysis, and data interpretation for at least 15 publications in 2018.

It provided methods, maintenance, and training for two triple quadrupole mass selective gas chromatographs (GC-MS/MS) and one triple-quadrupole mass selective liquid chromatograph (LC-MS/MS) that are heavily used for analysis of PCBs and OH-PCBs in over 1000 environmental and laboratory samples.

The AC assisted Projects 4 and 6 on the development and refinement of methods for determining the effective volume model for passive samplers equipped with polyurethane foam. These PUF-PAS samplers are deployed in indoor and outdoor homes, schools, and near contaminated waters that emit PCBs.

The AC supported Project 4 with measurements of PCBs in air and water for flux determinations. It assisted Project 4 in studies of PCB emissions from kitchen cabinets and freshly applied paint. These studies required a PCB-free environment for trace level analysis.

It supported trainees from Project 3 and 6 and assisted their development of new methods for extracting and analyzing PCB sulfates in urine and serum resulting in one presentation. These studies required a PCB-free environment for trace level analysis.

The AC assisted Project 6 in measurements of PCBs in home air and supported Project 5 with measurements of PCBs in a contaminated wastewater lagoon. These studies were conducted in our high concentration laboratory to ensure the high levels of PCBs in the sediments would not contaminate other samples.

In collaboration with the Synthesis Core, the AC assisted Project 7 with the characterization of the exposure atmosphere and the measurements of PCBs in tissues from rats exposed to inhaled PCBs. It developed a collaboration with the Synthesis Core for novel computational methods for interpretation of complex chromatographic signals with triple quadrupole mass selective detection.

In collaboration with the Administrative Core and Synthesis Core the AC developed a statistical model to determine the concentration of all 837 OH-PCBs using GC-MS-MS for any sample extract. It continued to support the authentication of key chemicals, such as pure congeners of PCBs and their metabolites synthesized by the Synthesis Core.

It supported three publications with measurements of PCBs in collaboration with other institutions, University of Massachusetts Amherst (Roy et al 2018), the Boston University SRP (Tomsho et al 2018), and Northern Kentucky University (Klinefelter et al 2018).

The Analytical Core is working with data managers and data analysts from the University of Iowa Library to make the ISRP data more Findable, Accessible, Interoperable, and Reusable (FAIR). In addition, the two groups are organizing for all SRP researchers, staff, and trainees a FAIR workshop.

Recent Publications:

Herkert, N.J., J.C. Jahnke, and K.C. Hornbuckle, Emissions of Tetrachlorobiphenyls (PCBs 47, 51, and


Roy, M.A.; Sant, K.E.; Venezia, O.L.; Shipman, A.B.; McCornick, S.D.; Saktrakulkla, P.; Hornbuckle, K.C.; and Timme-Laragy, A.R. “The emerging contaminant 3,3’-dichlorobiphenyl (PCB 11) impedes Ahr activation and Cyp1a activity to modify embryotoxicity of Ahr ligands in the zebrafish embryo model (Danio rerio)” Environmental Health Perspectives, In review. [Analytical Core in collaboration with University of Massachusetts Amherst]


Core Leader: Keri C. Hornbuckle, PhD

Dr. Hornbuckle is the ISRP Director and Donald Bentley Professor of Engineering in the Department of Civil and Environmental Engineering. She is responsible for all aspects of the Analytical Core activities, including handling and extraction of samples and analysis by capillary gas chromatography (GC), liquid chromatography (HPLC), mass spectrometry, and various other analytical methods. Dr. Hornbuckle oversaw the development of automated air sample analysis Standard Operating Methods and methods for more specialized applications. She will consult directly with Project Leaders to refine analysis to maximize sensitivity and selectivity for PCBs and metabolites in various matrices.

Hans Joachim- Lehmler, PhD

Dr. Lehmler is a chemist with experience in the synthesis and analysis of PCBs in animal tissues with a special emphasis on the analysis of chiral PCB congeners. He is a professor in the UI Department for Occupational and Environmental Health. In addition to being a member of the Analytical Core of the ISRP, he will also serve as the Leader of the Synthesis Core. This will facilitate the interaction between the Analytical and Synthesis Cores.

Ananya Sen Gupta, PhD

Dr. Sen Gupta will lead studies concerning complex instrumental signals produced through the analysis of hundreds of air samples collected by the ISRP Projects. She is an Assistant Professor at the University of Iowa who has collected and analyzed for PCBs and related compounds since 2006.
Kai Wang, PhD.

Dr. Wang is a Professor in Biostatistics at the University of Iowa. His research interests include the application and development of statistical technologies related to biomedical studies including bioinformatics, statistical genetics, and nonparametric estimation under biased sampling.

Attach files:  AC Sample Priority Analysis Plan [8]

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