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Microsampling and Screening Technologies for Human Biomonitoring of Selected Persistent Organic Pollutants (POPs)

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Background. Human exposure to POPs (e.g. Dioxins, PCBs,...) is of concern. During biomonitoring campaign, individual bodyburden is estimated by measurements of serum levels. Depending on the analytes, up to 50 mL of serum are required from patients. This is negatively perceived and excludes young infants/elderlies from being sampled.
Objectives. In the quest for an easy to use and non-invasive sampling method, we have been investigating alternative microsampling approaches to reduce the level of invasiveness while maintaining the requested sensitivity. Several gas chromatographic (GC) and mass spectrometric (MS) methods have been studied to measure at sub picogram (pg) LOQ level. The aim was to keep sample volumes below 50 µL.
Methods. Dried-blood spots (DBS), processed using micro-extraction by packed sorbent (MEPS) were analyzed by cryogenic zone compression (CZC) coupled to negative chemical ionization (NCI), and high resolution time-of-flight MS (HRTOFMS). We also developed a very sensitive method based on the use of volumetric absorptive microsampling (VAMS) and GC coupled to triple quadrupole tandem in-space MS (GC-QQQMS/MS) for measurements. CZC measurements were also implemented using a sector MS instrument to take advantage of the most sensitive MS analyzer operating in selected ion monitoring (SIM) at high acquisition rates. Isotope dilution (ID) was used in all approaches.
Results. CZC applied to GC-NCI-IDHRTOFMS was used for the screening of markers of exposure (PCB-153, DDE) in 20 µL serum samples. The use of MEPS was automated with success and required only 500 µL of solvent for extraction. The non-scanning HRTOFMS analyzer makes analyses of other unknown and/or emerging compounds possible in the future. VAMS and GC-IDQQQMS/MS allowed to measure levels of 24 OCPs and 6 non dioxin-like PCBs (NDL-PCBs) in 40 µL whole blood. The sample preparation, involving micro-scale solid phase extraction (SPE), used 2 mL of solvent per sample. We reported analyte levels for a series of real human samples.
Conclusion. These minimally-invasive methods offer an alternative to conventional approaches in order to easily gather data from people in remote area, from young infants, or for purposes where blood volumes are restricted to a minimum.