Exposure assessment to persistant organic pollutants

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Laboratory
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Subjects / Tools-Methodologies:
1 :Persistent organic pollutants (POP) / Extraction and chromatographic analyses
2 :Biomarker analysis / Analysis of POP in biological samples
3 :Risk assessment / Modelling

Summary of lab's interests

Laboratory 1 - UMR 214 Ingénierie analytique pour la qualité des aliments (Valérie CAMEL):
- Development and validation of rapid analytical methods for the estimation of food quality, especially considering the organic contaminants contents ;
- Development of chemometric tools for large data treatment

Laboratory 2 - UR Mét@risk (Philippe VERGER - co-supervisor of the PhD work) :
- Risk assessment;
- Development of models for the estimation of contaminants exposure via food consumption

Summary of project

In the past twenty years, numerous studies conducted on environmental contaminants, especially some epidemiological studies, have given evidence that these compounds have negative effects on human health as well as on ecosystems. Persistant organic pollutants (POPs), such as organochlorinated pesticides, dioxins, furans, polychlorobiphenyles (PCBs), and more recently polybromodiphenylethers (PBDEs, flame retardants) have given rise to the largest number of scientific studies ; indeed, their hydrophobic character induces a bioaccumulation of these molecules in living organisms, with life times estimated around ten to twenty years in humans . Now, besides suspected carcinogenic or mutagenic effects during chronic exposures, some of these compounds are well-known as endocrine disruptors (i.e. they disturb the hormonal functioning of the organism); strong suspicions are pressed on their involvement in the occurrence of some hormon-dependent cancers (i.e. breast, prostate and testicle cancers), in the observed decrease of human fertility, as well as in some congenital malformations of the reproductive system observed recently in young children . Consequently, there is a need to precisely assess the exposure of populations towards these contaminants. This is at present time mostly performed by means of modelling, by crossing mean contamination data of different food categories, with consumption data enabling the estimation of mean amounts of these foods that are ingested by the population. Yet, this indirect method faces several limits : (i) food diets within a population differ (depending on the age, the sex, or even consumption habits), which requires to perform detailed, fastidious and costly consumption studies ; (ii) it considers only exposure via ingestion, and other exposure pathways may not be excluded even though ingestion remains the

predominant pathway for some POPs such as PCBs and PBDEs ; (iii) only the external exposure is estimated, which can in some cases result in an overestimation of risks, as the internal exposition may be lower. By way of consequence, another method is being more and more used for precisely assessing exposure to these contaminants : the direct analysis of biomarkers in biological samples. This method takes into account all the exposure pathways, and it gives an estimation of the internal exposure ; in that way it is more pertinent than the indirect method for risk assessment. It consists of analysing either the contaminants of interest, or their metabolites ; this depends on the remanent character of the molecules in the different biological matrices. In the case of POPs, their high persistence allows to look for the contaminants themselves, in a wide range of biological matrices such as serum, urine and adipose tissues. In practice, looking for these different biomarkers in biological matrices faces several constraints: (i) the choice of the biological matrix is strongly related to the type of biomarker analysed; (ii) the biological matrix sampling needs to be the less invasive as possible ; (iii) there is a need to use sensitive and selective analytical procedures as biomarkers are present at very low concentrations; (iv) it is difficult to get a large number of biological samples, which should be required for risk assessment. Consequently, these two approaches of exposure assessment, direct (biomarker analysis) and indirect (modelling), are complementary. Both will be considered in that work, in order to assess population exposure to POPs. Indeed, despite recent work , there is a lack of data in France, so that it is urgent to conduct studies in that field. For biomarkers of exposure, human samples will be obtained via the Human Nutrition Research Center, and analysed using chromatography coupled to mass spectrometry after an adapted sample treatment. Modelling of food exposure will relie on data bases of individual consumption over seven days and those of family consumption over years; their crossing with contamination data obtained from official controls, taking into account kinetics of POP elimination, will enable to simulate the more realistic exposure as possible. Results obtained using these two approaches (biomarker analysis and modelling) will be compared : hence, they will allow either to validate the predictive model of risk assessment, or to rebuild this model on data obtained by the biomarkers analysis. Besides, exposure data obtained for the French population will be compared to data from other countries, especially Iceland (Hubert Curien partnership with the University of Iceland on that topic). Required knowledges and competencies : Knowledges : chromatographic techniques (knowledge on their coupling to mass spectrometry is welcome) ; extraction / clean-up techniques for sample treatment before analysis ; statistics. Competencies : control of chromatographic techniques ; control of sample treatment techniques (LLE, Soxhlet, SPE) ; control of statistic softwares.