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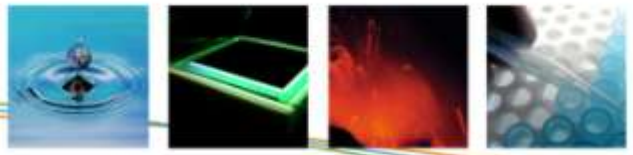

27/06/2012

Non-invasive bio-monitoring and exposure assessment of flame retardant chemicals

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INFLAME set-up

Scientist	Institution	Country	Project title
ESR 1	UA	BE	Migration Pathways to the environment – ”Horizon Scanning” for FRs present in consumer goods and construction materials
ESR 2	UB	UK	Using forensic microscopy to elu pathways of halogenated FR migration into indoor dust.
ESR 3	VITO	BE	Determining FR emi om treated goods
ESR 4	IVL	SE	Modelling ind and fate of FRs
ESR 5	SU	SE	Deter ntribution of indoor air ventilation to outdoor contamination
ER 1	VU	NL	on Pathways to the environment –”Horizon Scanning” for FRs present in e-waste
ESR 6	NIPH	NO	An experimental approach to ex ing correlation between external exposure and human body burdens
ESR 7	UOR	UK	Determining the bio FRs in indoor dust
ESR 8	VU	NL	The relevanc t for human exposure
ESR 9 - AGA	VITO	BE	Dev vasive methods for monitoring human body burdens
ER 2	SU	SE	Ex g correlation between external exposure and human body burdens – a modelling approach
ESR 10	UA	BE	Mechanistic profiling of fl me FRs in general systemic stress and endocrine disruption
ESR 11	UB	UK	A transcripto bolomic approach to biomarkers of exposure and effect
ESR 12	UvA	NL	The role of ndoor dust in potentiating/facilitating allergic responses to inhaled allergens

PRODUCT MIGRATION

HUMAN EXPOSURE

EFFECTS

Non-invasive bio-monitoring and exposure assessme… …, flame retardant chemicals

» Objective

The development and validation of non-invasive methods for the monitoring of human body burdens; exploration of the utility of non-invasive matrices like hair, saliva, nails and urine as biomarkers of internal exposure to flame retardants (FR)




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Global work program

- Literature study:
  - non-invasive methods for POPs
  - analytical techniques for the determination of brominated and non-brominated flame retardants and their metabolites
- Definition of target FR (common and novel) and metabolites; prediction of possible metabolites
- Comparison of detection techniques and selection of most appropriate technique(s) based on LOD, selectivity, reproducibility, ease of operation and cost:

GC-(EI)MS GC-(EI)HRMS GC-(CI)MS GCXGC-MS
GC-MS/MS LC-(ESI)MS/MS LC-(APCI)MS/MS
LC-(APPI)MS/MS LC-ICP-MS

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- Development of suitable analytical procedures for the determination of the target compounds in non-invasive matrices:
  - Extraction procedures (PLE, Soxhlet, USE, …)
  - Clean up procedures (SPE, column chromatography, GPC, liquid/liquid partition …)
  - Derivatisation procedures (optional for metabolites)
- Implementation/development of suitable analytical procedures for the determination of the target compounds in serum – cfr NIPH
- Determination of the overall method performance (on the basis of real samples, reference materials, matrix addition experiments)
- Assessment of the utility of non-invasive biomonitoring: comparison of non-invasive and invasive analytical data (based on limited scale monitoring of laboratory volunteers)

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Monitoring of FR in non-invasive human samples collected from mothers and children in Norway

- Results
  - Validated analytical procedures for the assessment of the degree of exposure to FR by means of non-invasive monitoring
  - Case study: exposure results for a limited population in Norway and comparison between non-invasive and invasive biomonitoring

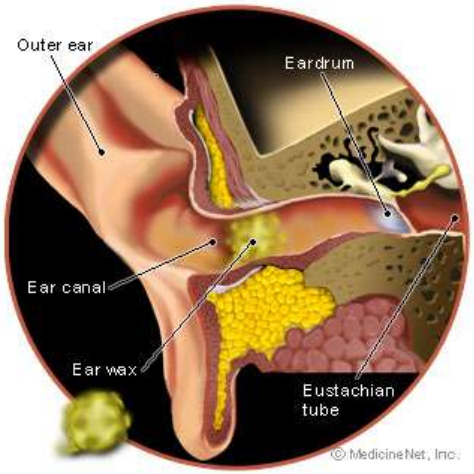
Hair Sample Preparation Procedure

- Sampling – far from perfect - (Standard Operating Procedure for Scalp Hair Sampling – COPHES)
- Washing – with deionized water
- Drying - with a paper towel
- Cutting into small pieces with stainless scissors

- **Pulverization – Retsch Mixer Mill MM200**
- 500 mg of hair sample + IS
- Incubation overnight at 40 °C with 5 ml hex:DCM (4:1 v/v) and 5 ml of 3N HCl
- LLE – 2x5ml hex:DCM (4:1 v/v)
- Cleaning up on a glass gartridge filled with acidified silica gel and anh. Na_2SO_4
- Elution with hexane (3x2 ml)
- Evaporation under N_2 stream
- Reconstitution to 100 µL in toluene

The new bright idea… Ear wax/smear

Ear wax (cerumen) - a yellowish **waxy substance** secreted in the ear canal of humans and other mammals. It protects the skin of the human ear canal, assists in cleaning and lubrication, and also provides some protection from bacteria, fungi, insects and water.



Advantages:

Non-invasive

Lipid content – up to 64%

Fatty acids, cholesterol, ceramides, squalene, cholesterol esters, wax esters, triacylglycerol, cholesterol sulfate, …

J.AmAcad.Dermatol.1990 –Bortz JT. – Composition of cerumen lipids

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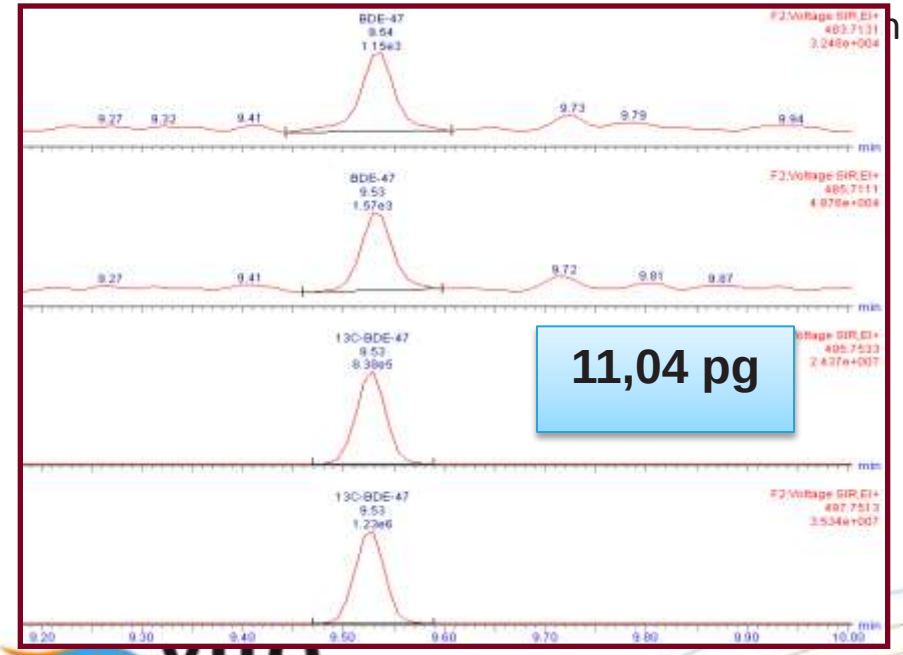
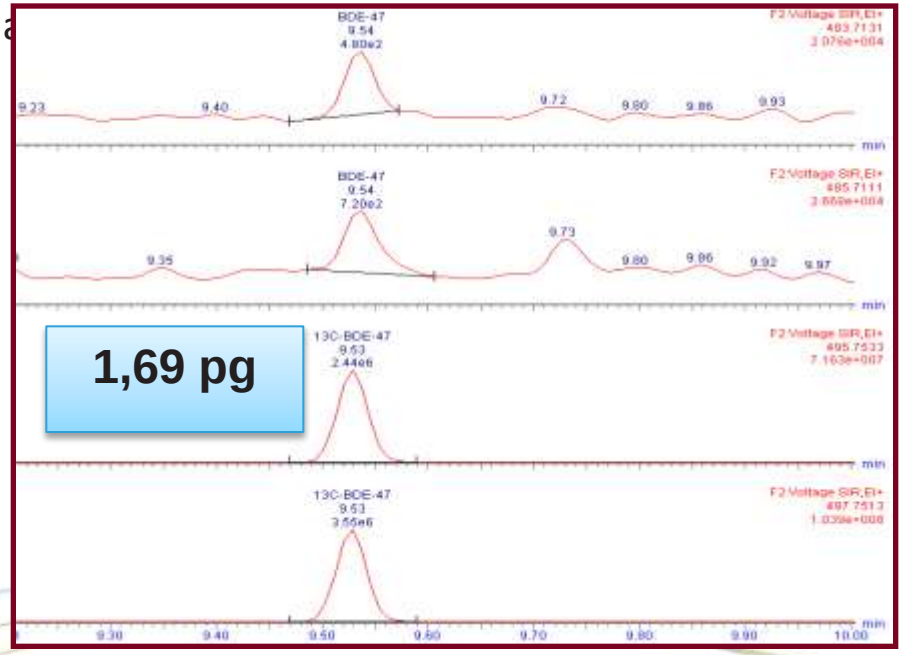
Tentative sample preparation procedure

19,0 mg

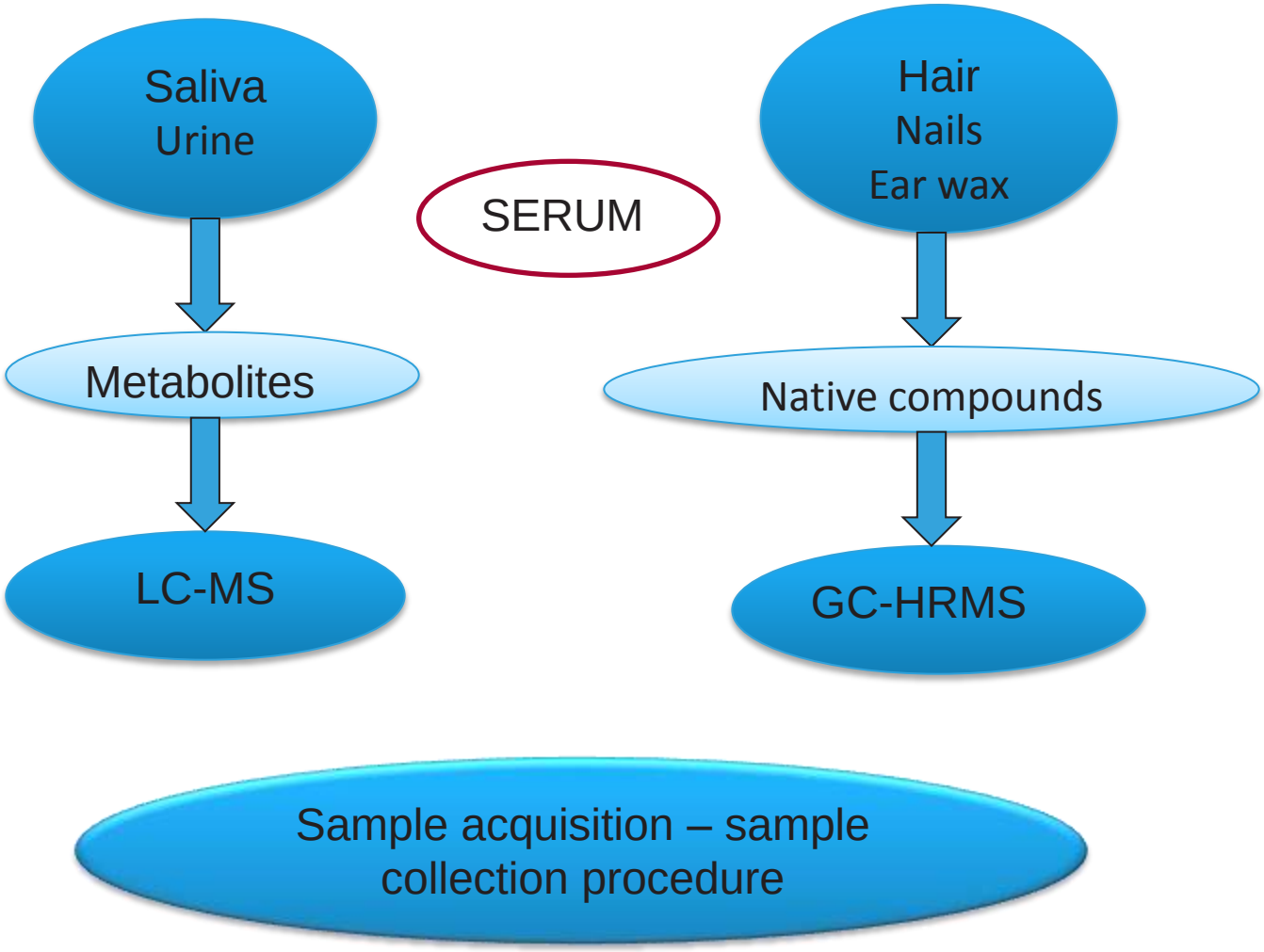
» Extraction procedure:

- Sample + 50 µl of IS
- USP assisted extraction with 10 mL of hexane (over 1h)
- LLE with 2 x 10 mL of hexane (USP; 5min)
- Cleaning up on a glass cartridge filled with acidified silica gel + anhydrous Na_2SO_4
- Reconstitution in 50 µL (toluene)





Conclusion



Thank you
for your attention