New Methodologies for POPs Analysis using Orbitrap GC-MS in Official Food Control

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Vancouver, August 22nd, 2017

C S B Consorci Sanitari de Barcelona

Agència de Salut Pública

Summary

- Laboratori Agència de Salut Pública de Barcelona
- Orbitrap™ technology
- Brominated Flame Retardants: PBDEs
- Polychloronaphtalenes
- Ndl-PCBs

Laboratori Agència de Salut Pública

Food Safety

Regulations

Accreditation

The official control labs should:

- help to ensure food safety
- fulfill regulations
- work under accreditation ISO/IEC 17025

Laboratori Agència de Salut Pública

Regulations

COMMISSION DECISION

of 12 August 2002

implementing Council Directive 96/23/EC concerning the performance of analytical methods and the interpretation of results

(notified under document number C(2002) 3044)

(Text with EEA relevance)

(2002/657/EC)

INSTRUMENTATION

Table 5

The relationship between a range of classes of mass fragment and identification points earned

MS technique	Identification points earned per ion
Low resolution mass spectrometry (LR)	1,0
LR-MS^n precursor ion	1,0
LR-MS^n transition products	1,5
HRMS	2,0
HR- MS^n precursor ion	2,0
HR-MS^n transition products	2,5

VALIDATION

Model-independent and model-dependent performance parameters

Validation		
Model-independent performance parameters	Model-dependent performance parameters	
Common performance characteristics (3.1.1)	Conventional validation approach (3.1.2)	In-house validation approach (3.1.3)
Specificity	Recovery	Recovery
Trueness	Repeatability	Repeatability
Ruggedness: minor changes	Within-laboratory reproducibility	Within-laboratory reproducibility
Stability	Reproducibility	Reproducibility
	Decision limit (CCα)	Decision limit (CCα)
	Detection capability (CCβ)	Detection capability (CCβ)
	Calibration curves	Calibration curve
	Ruggedness: major changes	Ruggedness

CODEX ALIMENTARIUS COMMISSION E

Food and Agriculture Organization of the United Nations

World Health Organization

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Agenda Item 1 CX/RVDF 12/20/1

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON RESIDUES OF VETERINARY DRUGS IN FOODS

Twentieth Session

San Juan, Puerto Rico, 7-11 May 2012

The session will be held at the Hotel Sheraton Puerto Rico, 200 Convention Boulevard, San Juan, Puerto Rico from Monday, 7 May at 10.00 hours to Friday, 11 May 2012

Guidance document on analytical quality control and method validation procedures for pesticides residues analysis in food and feed.

SANTE/11945/2015

Supersedes

SANCO/12571/2013

Implemented by 01/01/2016

6.4.2017 EN Official Journal of the European Union L 92/9

COMMISSION REGULATION (EU) 2017/644

of 5 April 2017

laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs and repealing Regulation (EU) No 589/2014

Laboratori Agència de Salut Pública

Food Safety

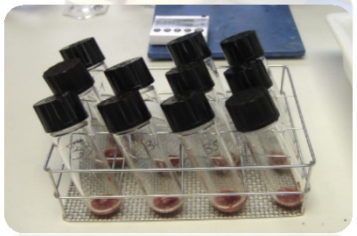
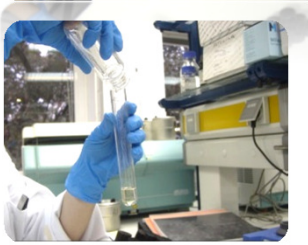


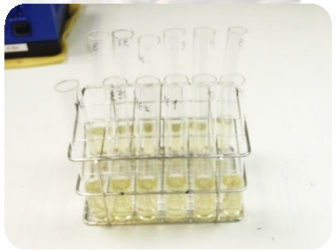




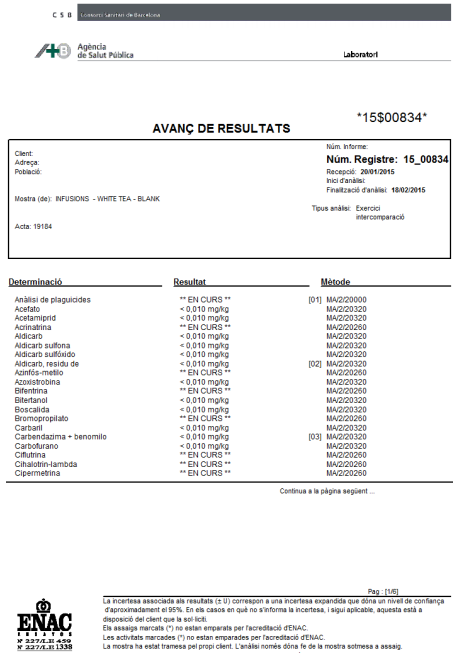










ISO International Organization for Standardization

ENAC Entidad Nacional de Acreditación

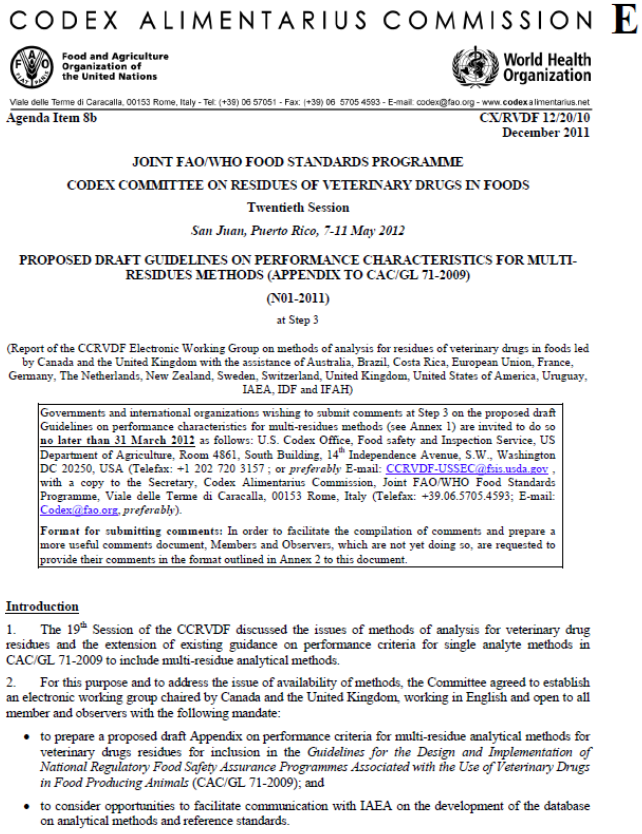
Accreditation

Method matrix matched standard calibration curve (MMSCC)

SCC (Standard calibration curve): calibration using standards in solvent

MSCC (Matrix matched standard calibration curve): addition of standards to sample extracts from blank matrix.

MMSCC (Method matrix matched standard calibration curve): addition of standards to blank matrix prior to extraction.



CODEX ALIMENTARIUS COMMISSION E

Food and Agriculture Organization of the United Nations — World Health Organization

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Agenda Item 8b — CX/RVDF 12/20/10 December 2011

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON RESIDUES OF VETERINARY DRUGS IN FOODS

Twentieth Session

San Juan, Puerto Rico, 7-11 May 2012

PROPOSED DRAFT GUIDELINES ON PERFORMANCE CHARACTERISTICS FOR MULTI-RESIDUES METHODS (APPENDIX TO CAC/GL 71-2009)

(N01-2011)

at Step 3

(Report of the CCRVDF Electronic Working Group on methods of analysis for residues of veterinary drugs in foods led by Canada and the United Kingdom with the assistance of Australia, Brazil, Costa Rica, European Union, France, Germany, The Netherlands, New Zealand, Sweden, Switzerland, United Kingdom, United States of America, Uruguay, IAEA, IDF and IFAH)

Governments and international organizations wishing to submit comments at Step 3 on the proposed draft Guidelines on performance characteristics for multi-residues methods (see Annex 1) are invited to do so **no later than 31 March 2012** as follows: U.S. Codex Office, Food safety and Inspection Service, US Department of Agriculture, Room 4861, South Building, 14th Independence Avenue, S.W., Washington DC 20250, USA (Telefax: +1 202 720 3157 ; or *preferably* E-mail: CCRVDF-USSEC@fas.usda.gov , with a copy to the Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, Viale delle Terme di Caracalla, 00153 Rome, Italy (Telefax: +39.06.5705.4593; E-mail: Codex@fao.org, *preferably*).

Format for submitting comments: In order to facilitate the compilation of comments and prepare a more useful comments document, Members and Observers, which are not yet doing so, are requested to provide their comments in the format outlined in Annex 2 to this document.

Introduction

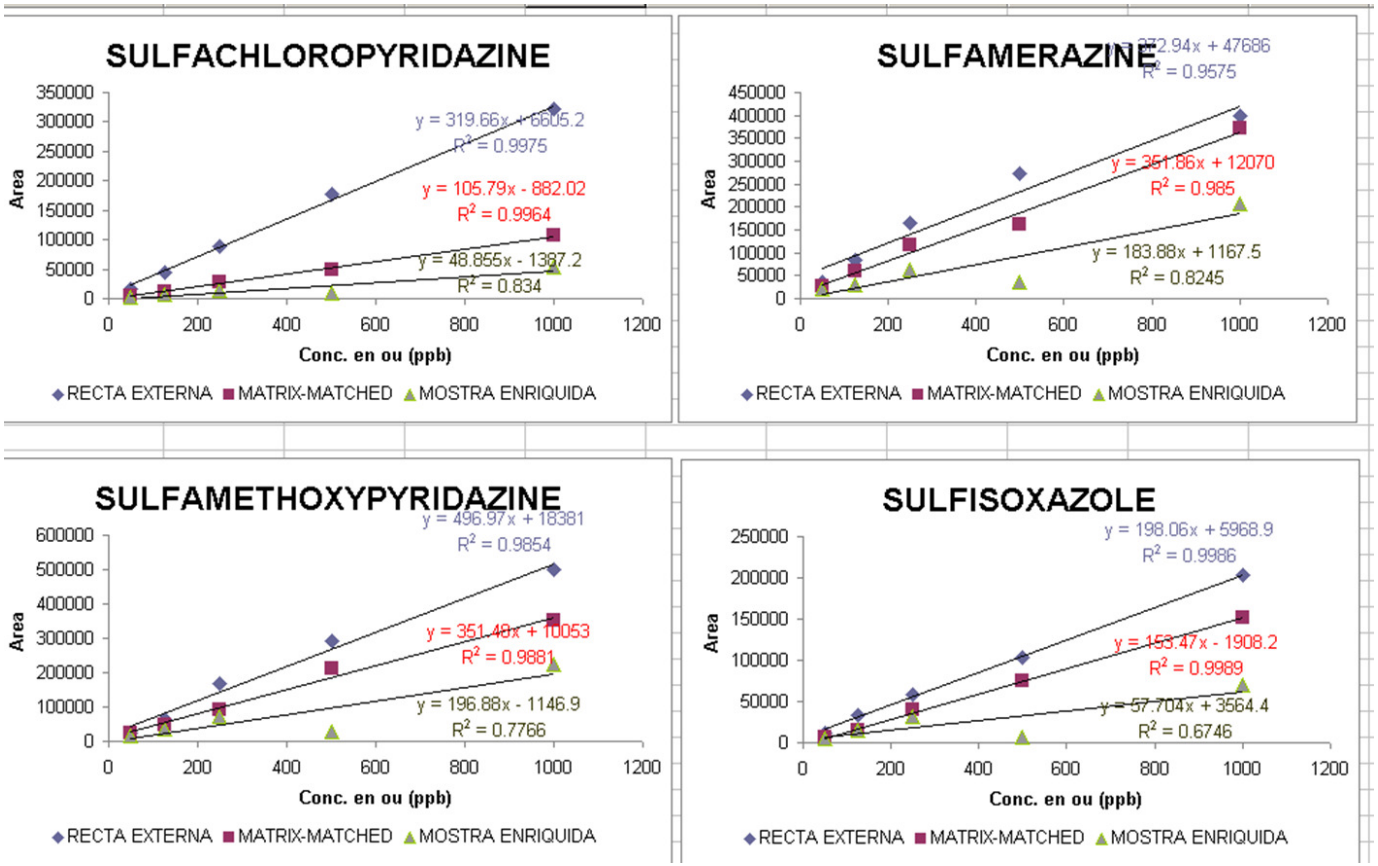
1. The 19th Session of the CCRVDF discussed the issues of methods of analysis for veterinary drug residues and the extension of existing guidance on performance criteria for single analyte methods in CAC/GL 71-2009 to include multi-residue analytical methods.

2. For this purpose and to address the issue of availability of methods, the Committee agreed to establish an electronic working group chaired by Canada and the United Kingdom, working in English and open to all member and observers with the following mandate:

- to prepare a proposed draft Appendix on performance criteria for multi-residue analytical methods for veterinary drugs residues for inclusion in the *Guidelines for the Design and Implementation of National Regulatory Food Safety Assurance Programmes Associated with the Use of Veterinary Drugs in Food Producing Animals* (CAC/GL 71-2009); and
- to consider opportunities to facilitate communication with IAEA on the development of the database on analytical methods and reference standards.

Method matrix matched standard calibration curve (MMSCC)

Matrix effect evaluation: egg analysis



Blue: SCC standards in solution

Red: MSCC Matrix matched

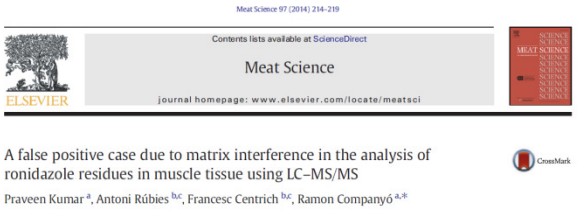
Green: MMSCC Matrix matched

Methods based on Orbitrap™ at LASPB

Analytical methods already in use:

ANALYSIS OF VETERINARY DRUGS:

- Antibiotics
- Hormones
- Chloramphenicol
- Beta agonists
- Nitrofurans
- Nonsteroidal anti-inflammatory drugs
- …..


Meat Science 97 (2014) 214–219

Contents lists available at ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

A false positive case due to matrix interference in the analysis of ronidazole residues in muscle tissue using LC–MS/MS

Praveen Kumar [a], Antoni Rúbies [b,c], Francesc Centrich [b,c], Ramon Companyó [a,*]


Analytica Chimica Acta 780 (2013) 65–73

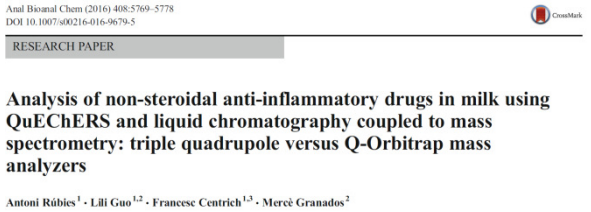
Contents lists available at SciVerse ScienceDirect

Analytica Chimica Acta

journal homepage: www.elsevier.com/locate/aca

Targeted analysis with benchtop quadrupole–orbitrap hybrid mass spectrometer: Application to determination of synthetic hormones in animal urine

Praveen Kumar [a], Antoni Rúbies [b,c], Francesc Centrich [b,c], Mercè Granados [a], Nuria Cortés-Francisco [d], Josep Caixach [d], Ramon Companyó [a,*]


Anal Bioanal Chem (2016) 408:5769–5778

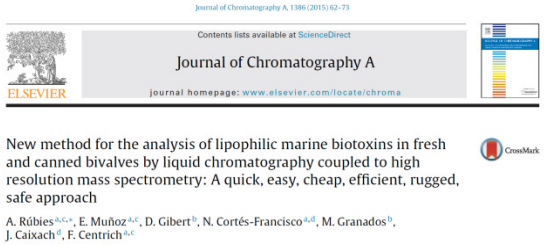
DOI 10.1007/s00216-016-9679-5

RESEARCH PAPER

Analysis of non-steroidal anti-inflammatory drugs in milk using QuEChERS and liquid chromatography coupled to mass spectrometry: triple quadrupole versus Q-Orbitrap mass analyzers

Antoni Rúbies [1] · Lili Guo [1,2] · Francesc Centrich [1,3] · Mercè Granados [2]

ANALYSIS OF MARINE BIOTOXINS


Journal of Chromatography A, 1386 (2015) 62–73

Contents lists available at ScienceDirect

Journal of Chromatography A

journal homepage: www.elsevier.com/locate/chroma

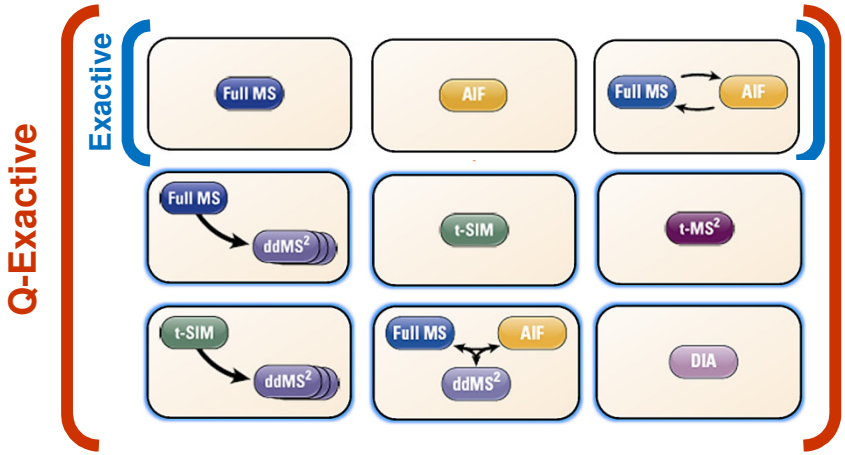
New method for the analysis of lipophilic marine biotoxins in fresh and canned bivalves by liquid chromatography coupled to high resolution mass spectrometry: A quick, easy, cheap, efficient, rugged, safe approach

A. Rúbies [a,c,*], E. Muñoz [a,c], D. Gibert [b], N. Cortés-Francisco [a,d], M. Granados [b], J. Caixach [d], F. Centrich [a,c]

ANALYSIS OF CONTAMINANTS FROM FOOD PACKAGING

ANALYSIS OF PROCESS CONTAMINANTS IN FOODSTUFF

New instrumentation: Orbitrap™ GC-MS



* Installed 14/12/2015

Brominated Flame Retardants: PBDEs

Polychloronaphtalenes (PCNs)

Ndl-Polychlorobiphenyls (ndl-PCBs)

Thermo Scientific Q Exactive GC system

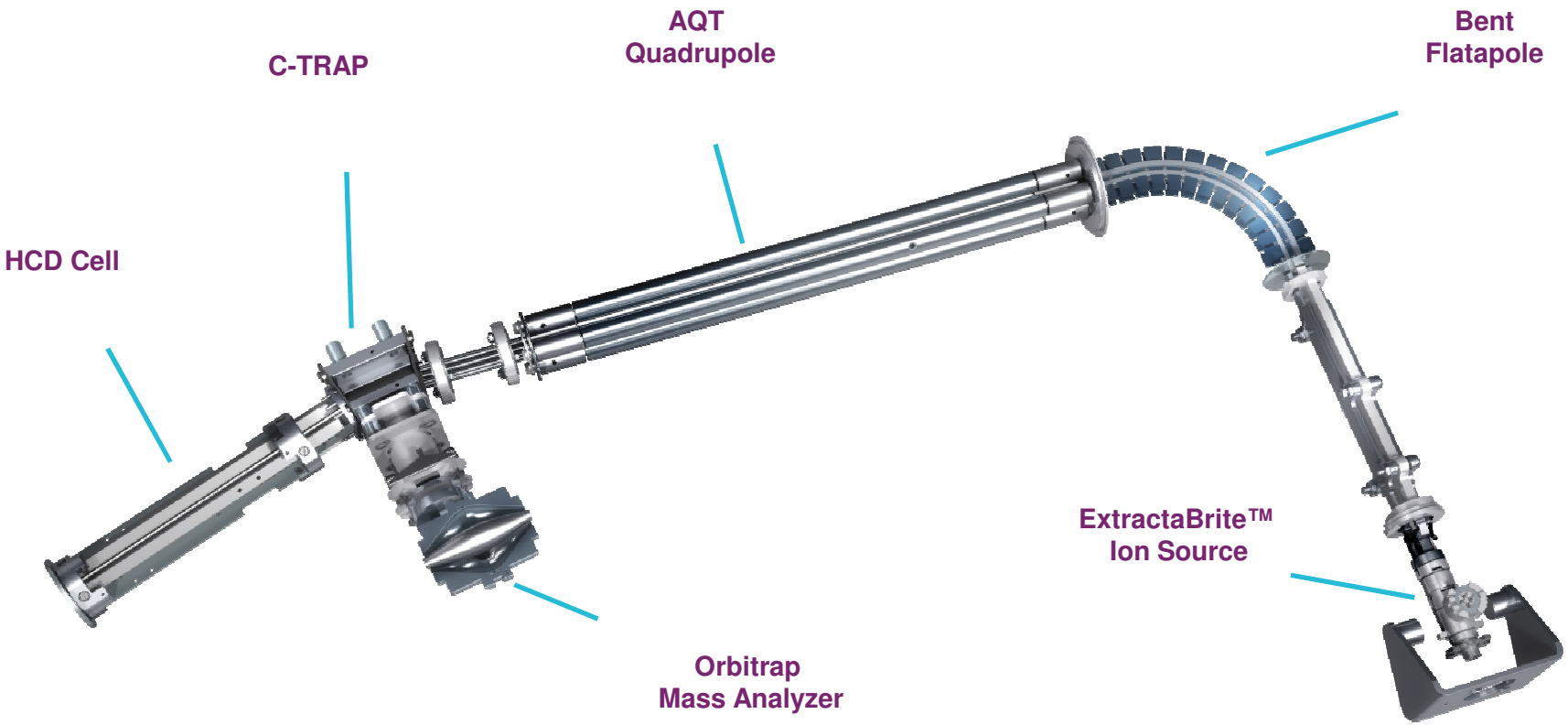
Unprecedented Depth in Analysis

RP 120,000 (FWHM @ *m/z* 200)

EI/CI; Full-scan, Timed-SIM

MS/MS capability

Bringing GC and Orbitrap Technology Together



* Courtesy of Thermo Fisher Scientific

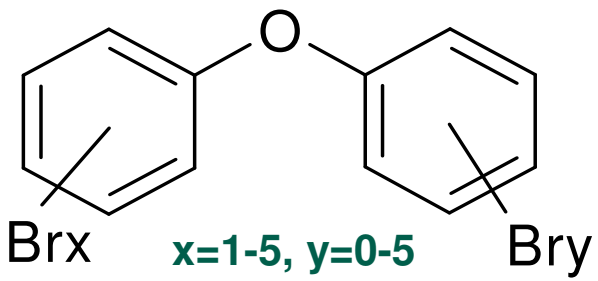
Polybrominated diphenyl ethers (PBDEs)

5.3.2014 EN Official Journal of the European Union L 65/39

COMMISSION RECOMMENDATION
of 3 March 2014
on the monitoring of traces of brominated flame retardants in food
(Text with EEA relevance)
(2014/118/EU)

(a) Polybrominated diphenyl ethers (PBDEs)

BDE – 28
BDE – 47
BDE – 49
BDE – 99
BDE – 100
BDE – 138
BDE – 153
BDE – 154
BDE – 183
BDE – 209



eggs and egg products

milk and dairy products

meat and meat products

animal and vegetable fats and oils

fish and other seafood

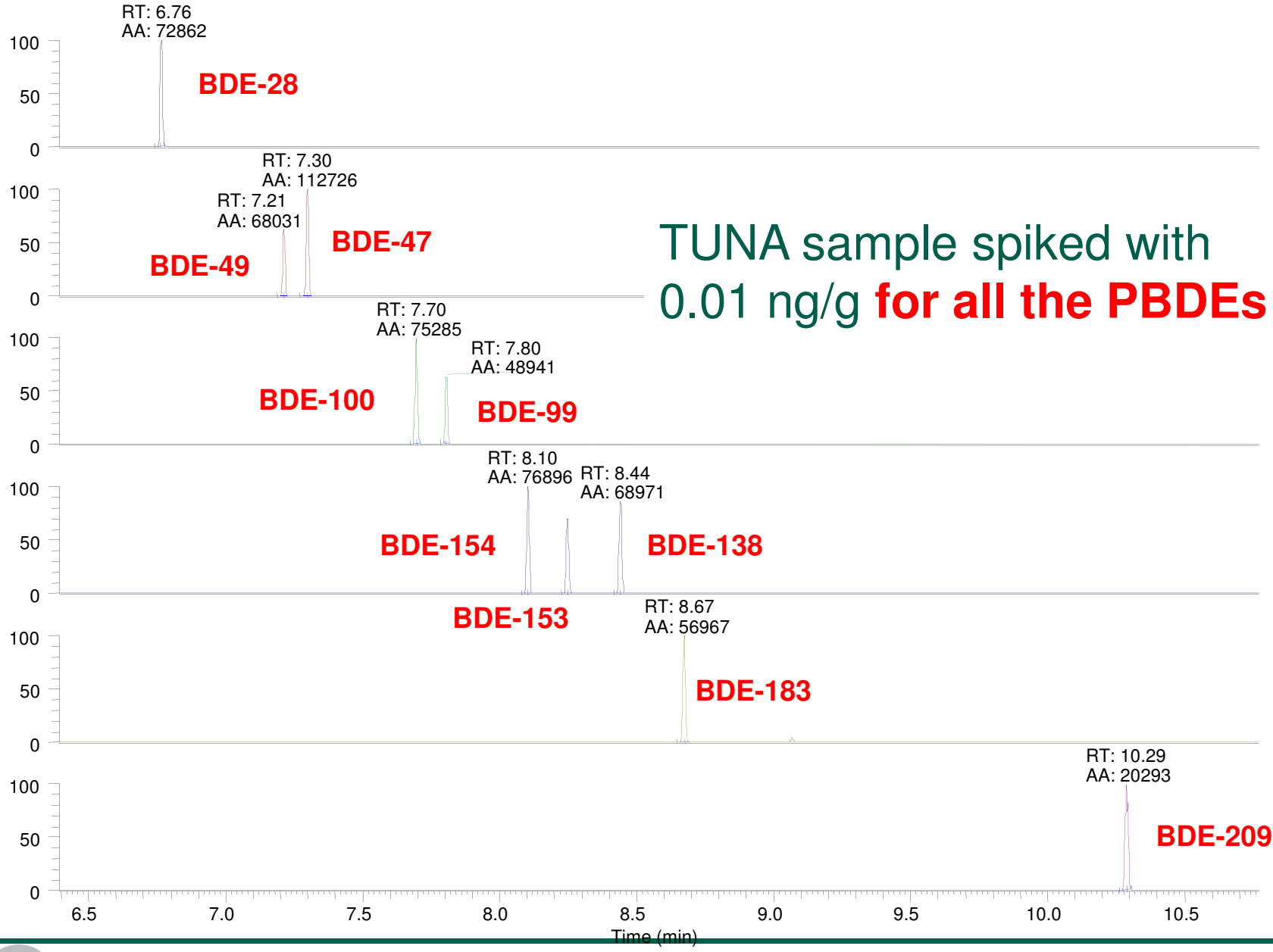
products for specific nutritional uses

food for infants and small children

Analytical methods with a limit of quantification of 0,01 ng/g wet weight or lower

10 ppt in the sample

Polybrominated diphenyl ethers (PBDEs)



TUNA sample spiked with 0.01 ng/g **for all the PBDEs**

HRMS approach

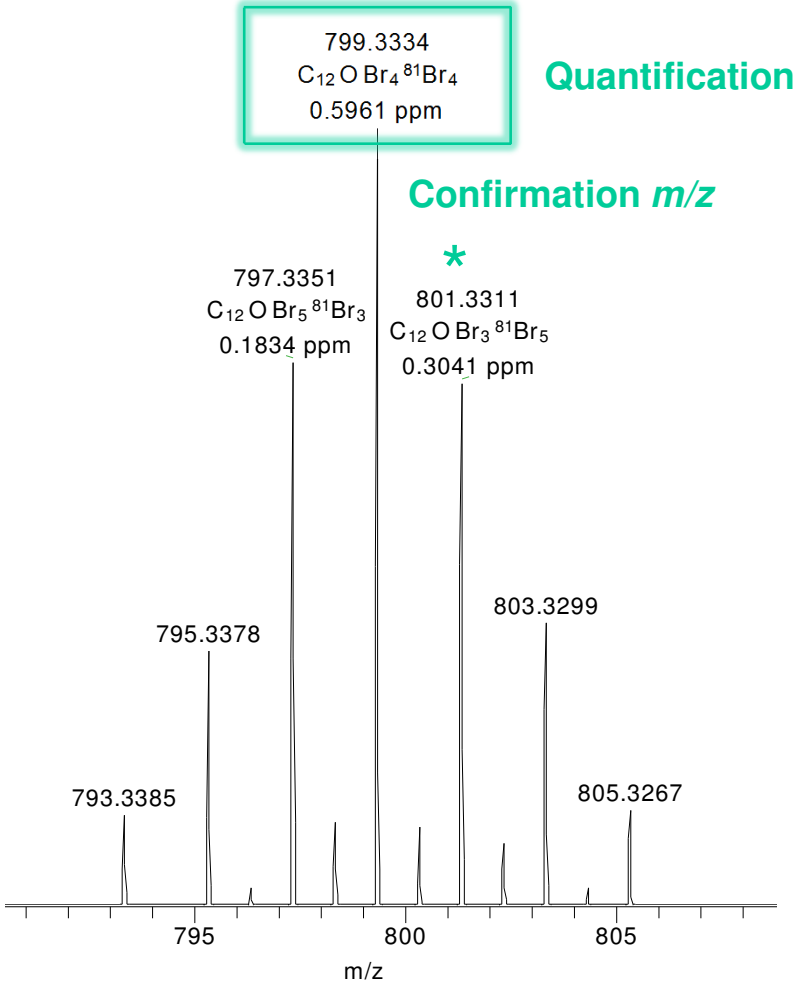
EPA United States Environmental Protection Agency

Method 1614A
Brominated Diphenyl Ethers in Water, Soil, Sediment, and Tissue by HRGC/HRMS

May 2010

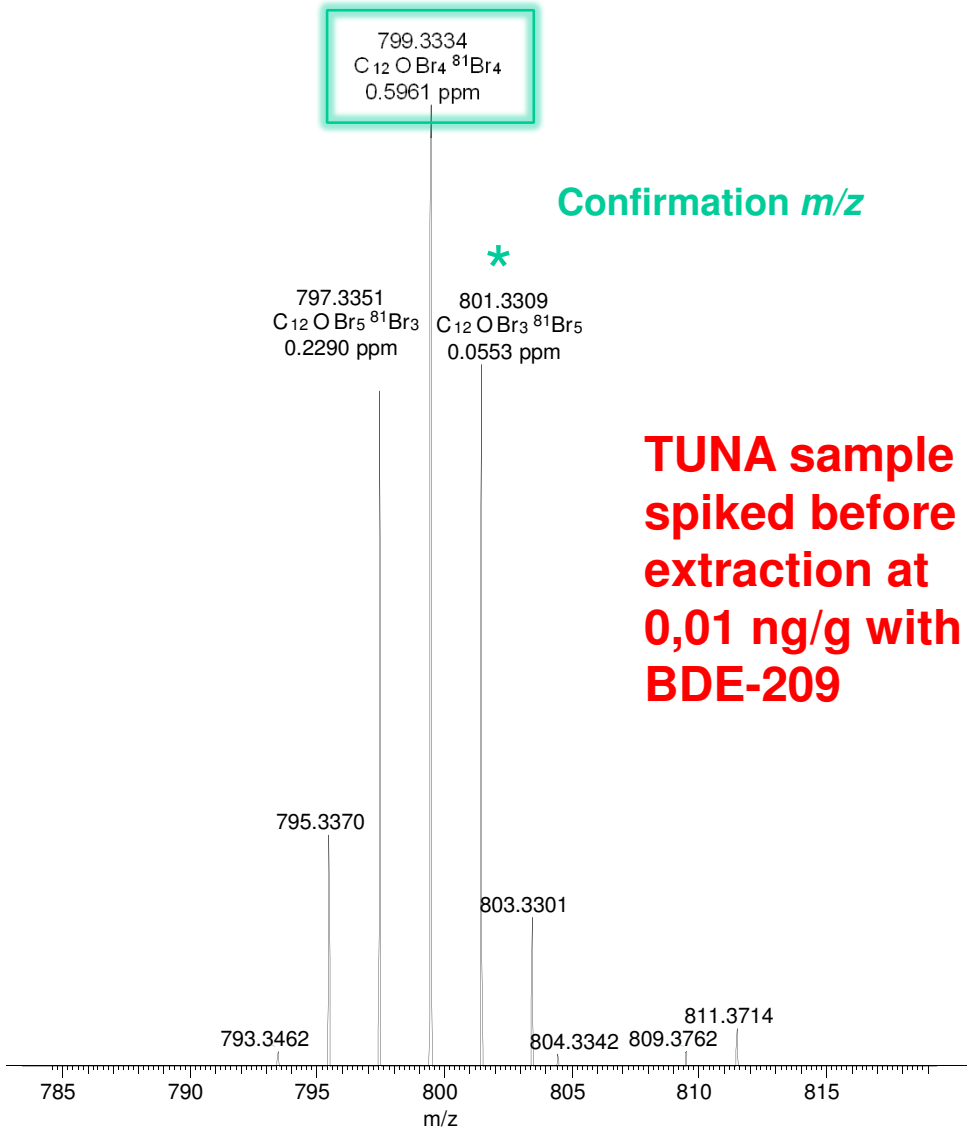
2.3 After cleanup, the extract is concentrated to 20 µL and labeled injection internal standards are added. An aliquot of the extract is injected into the gas chromatograph (GC). The analytes are separated by the **GC and detected by a high-resolution (≥5000) mass spectrometer. Two exact m/z's are monitored at each level of bromination (LOB)** throughout a pre-determined retention time window.

With the new HRMS instruments we are capable of acquiring the full isotopic pattern without losing sensitivity and working at R: 30,000 (FWHM, *m/z* 200) or higher.



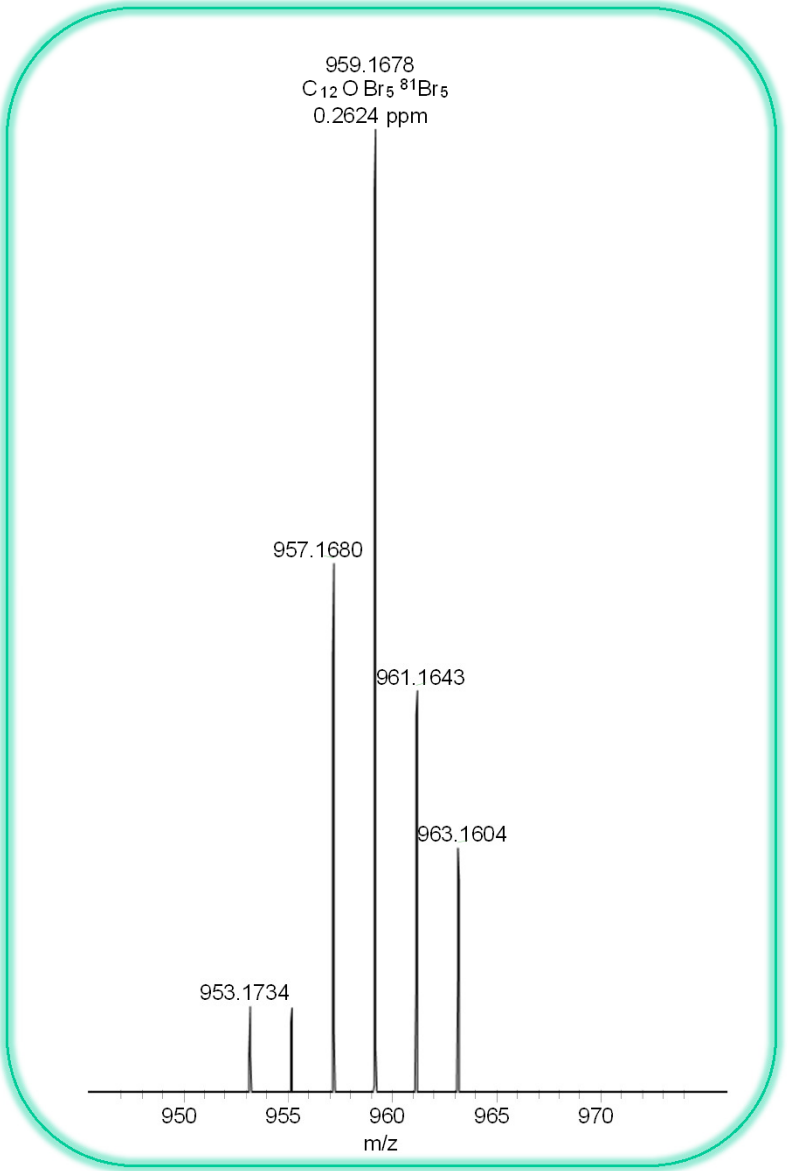
HRMS approach

Quantification *m/z*

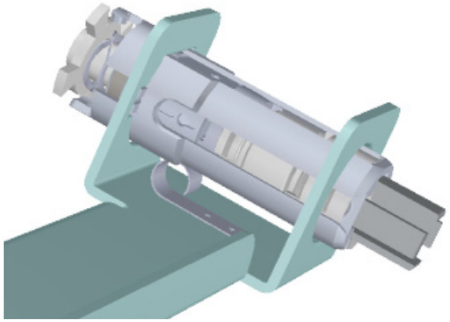


TUNA sample spiked before extraction at 0,01 ng/g with BDE-209

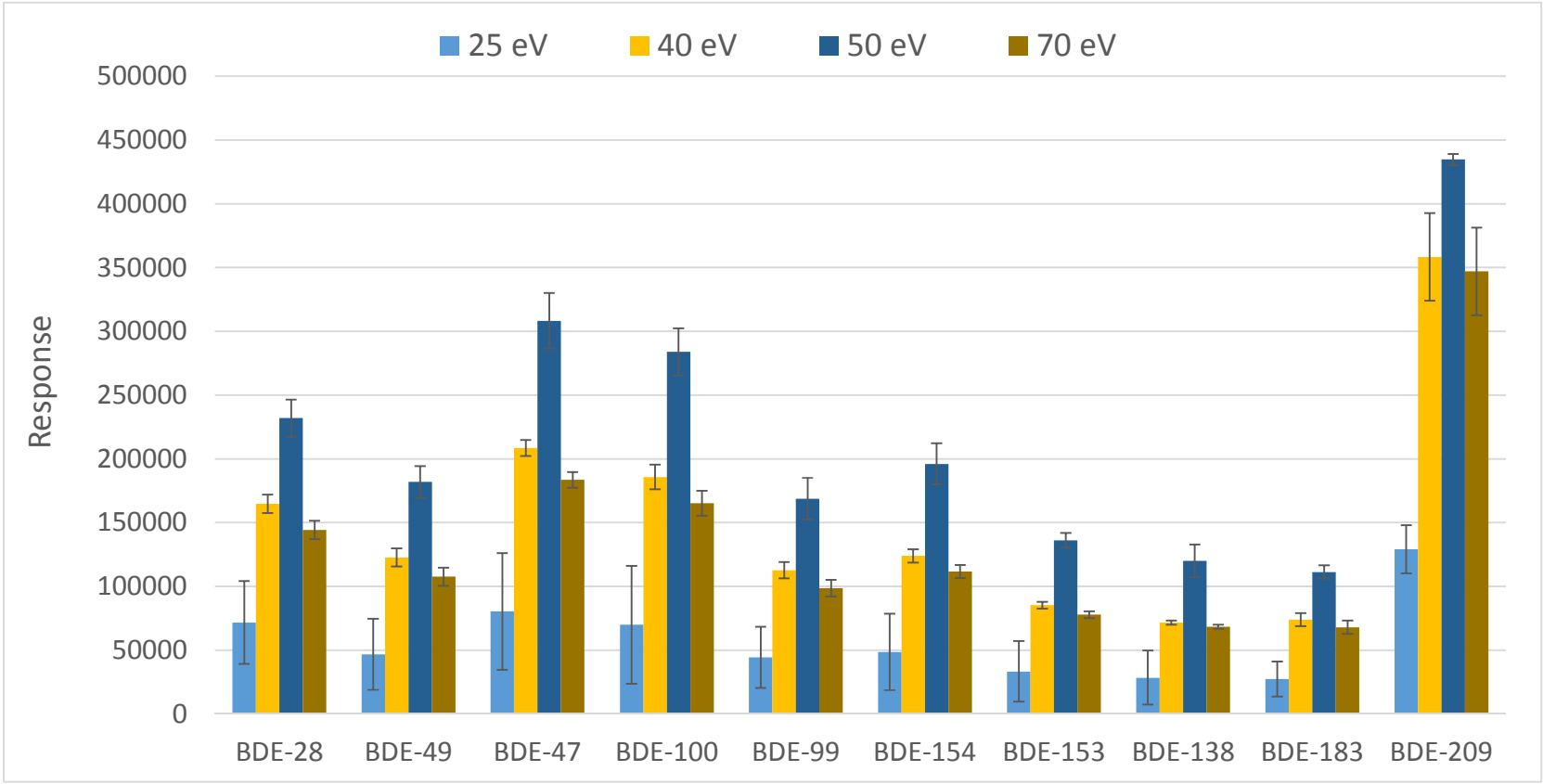
MOLECULAR ION



Optimization of EI Source Parameters

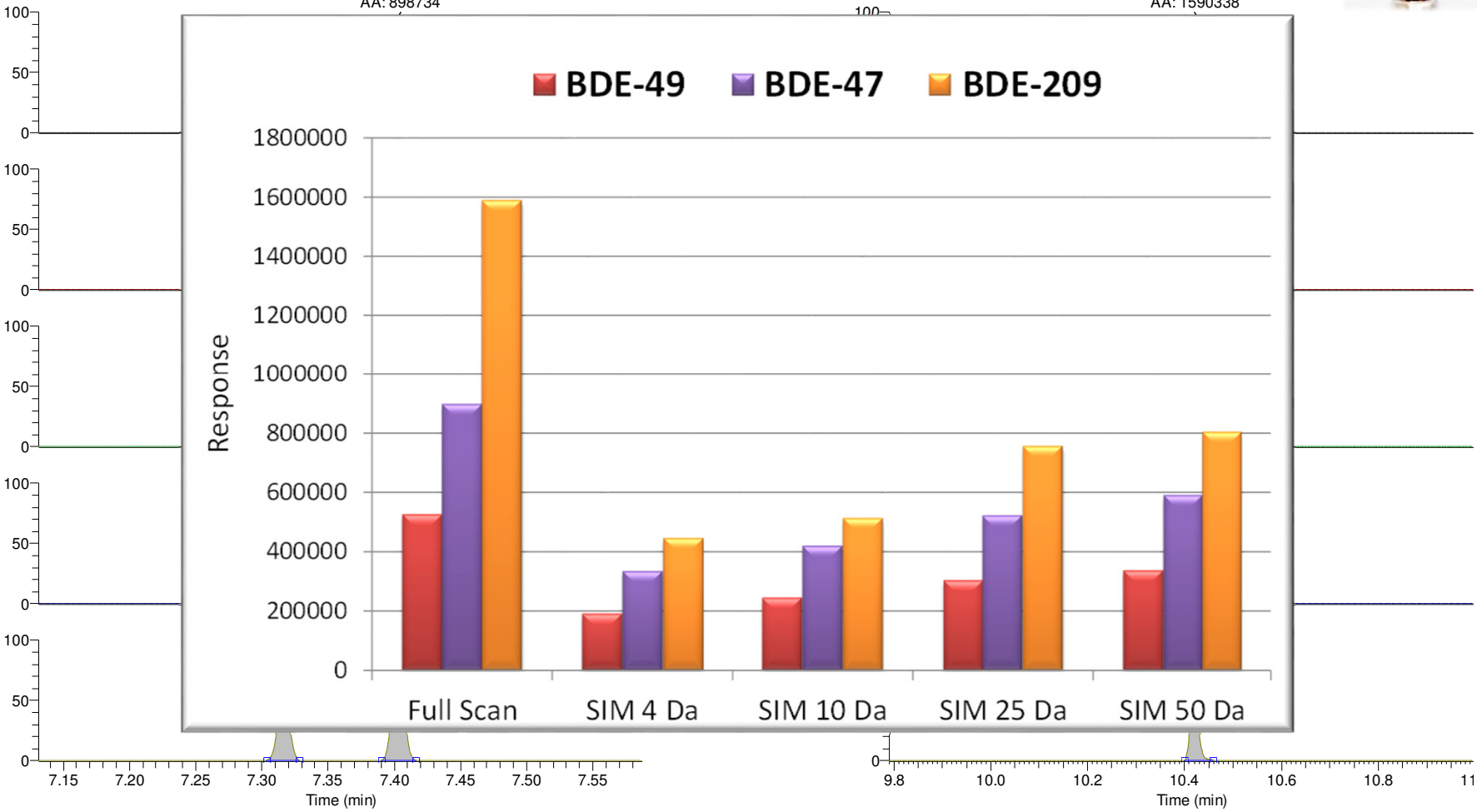


Tune values	
Source offset voltage * (V)	3.5
Electron lens voltage * (V)	15.0
Emission current * (uA)	50.0
Electron energy * (eV)	50
Repeller voltage * (V)	12.75
Lens 1 voltage * (V)	36.25
Lens 2 voltage * (V)	0.5
Lens 3 voltage * (V)	27.75
C-Trap energy offset * (V)	0.0



Acquisition modes

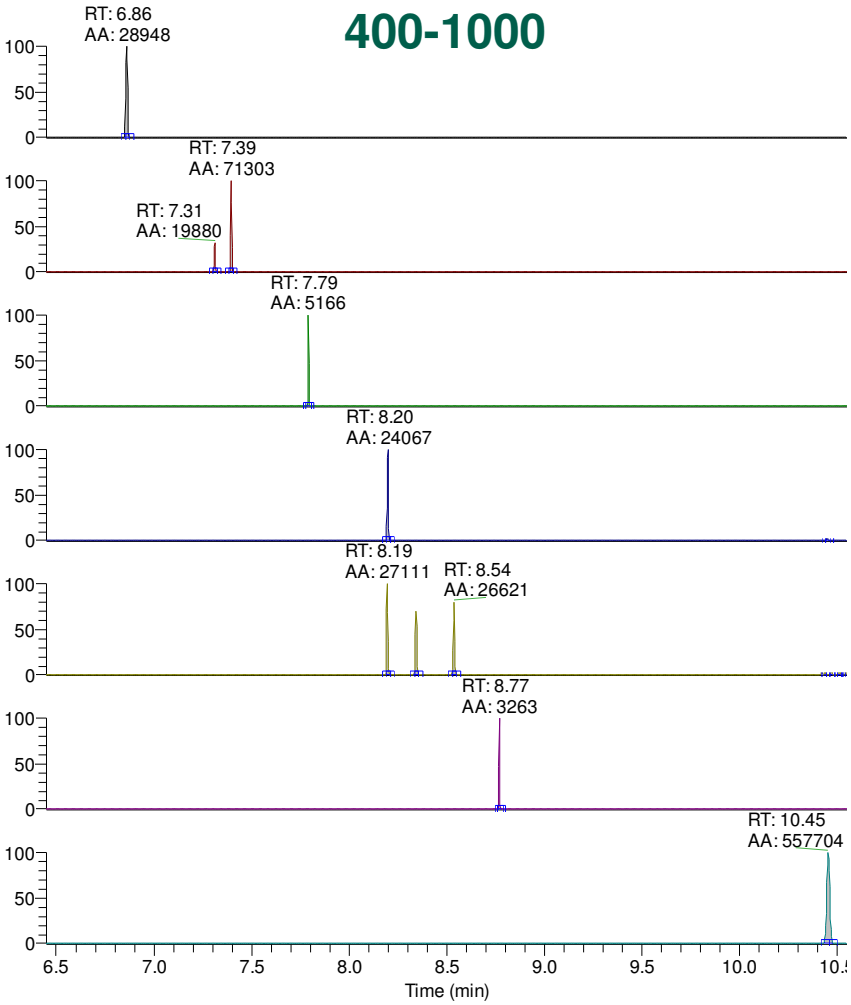
0.5 µg/L PBDE standard



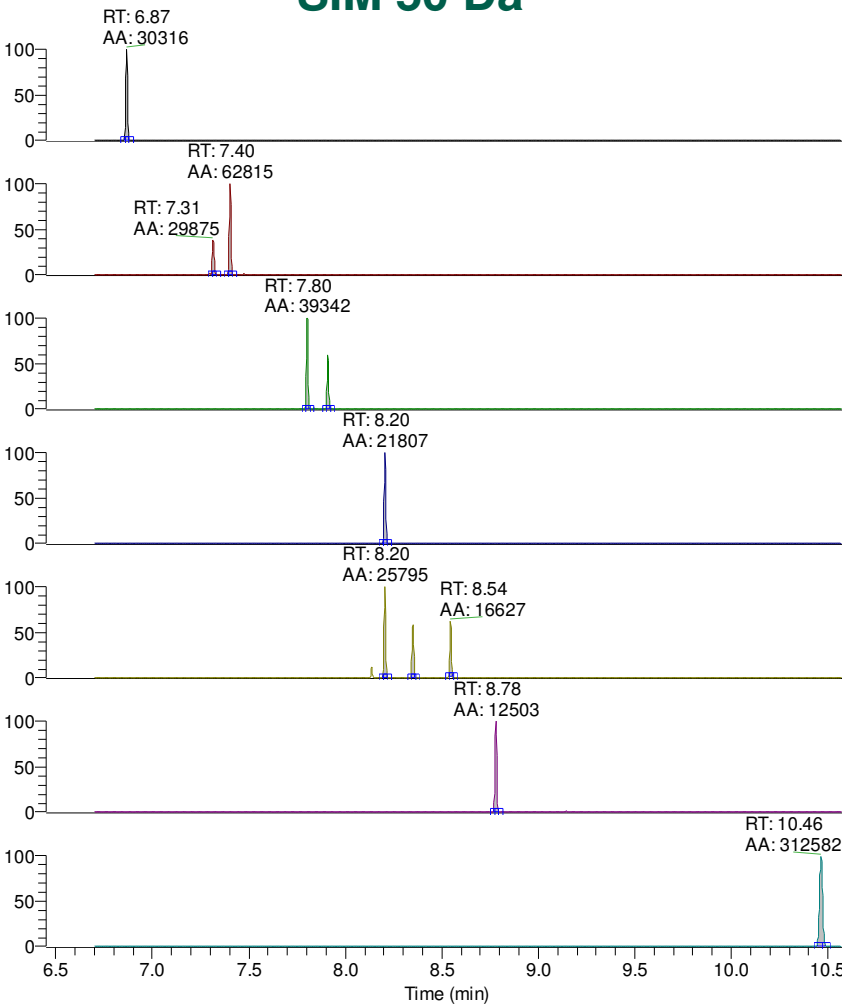
Acquisition modes

TUNA sample spiked with 0,01 ng/g

Full Scan *m/z* 400-1000



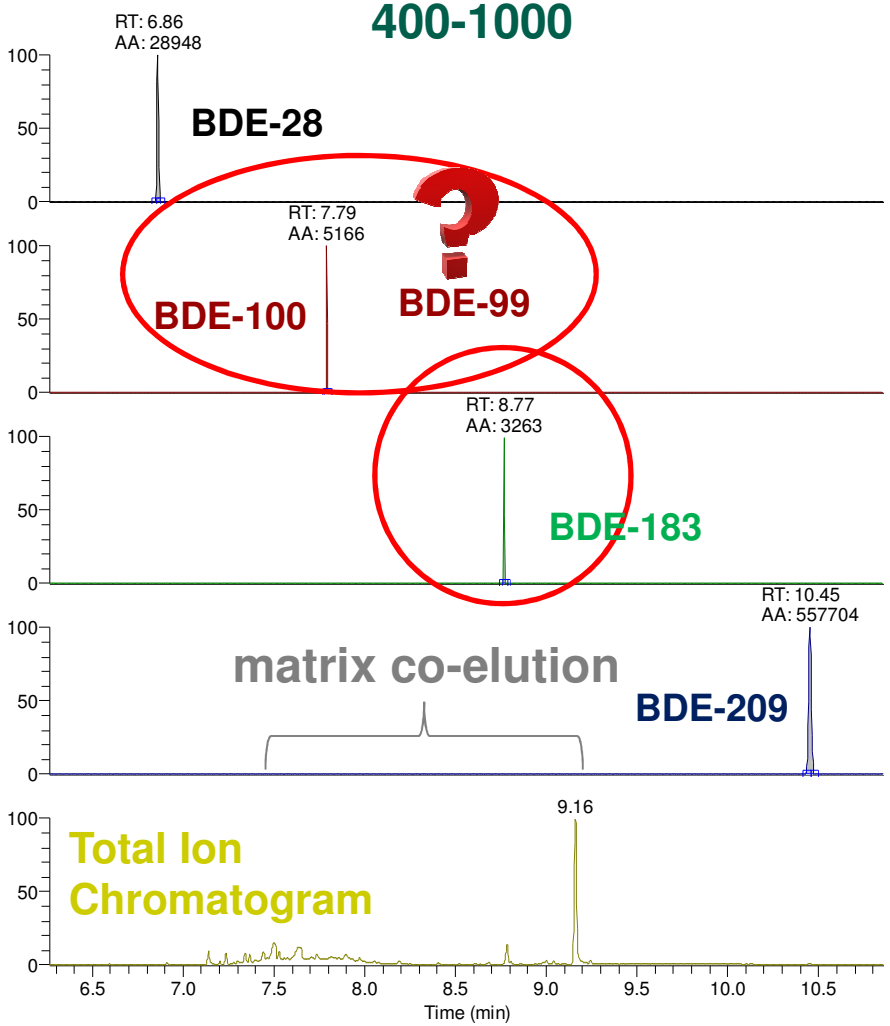
SIM 50 Da



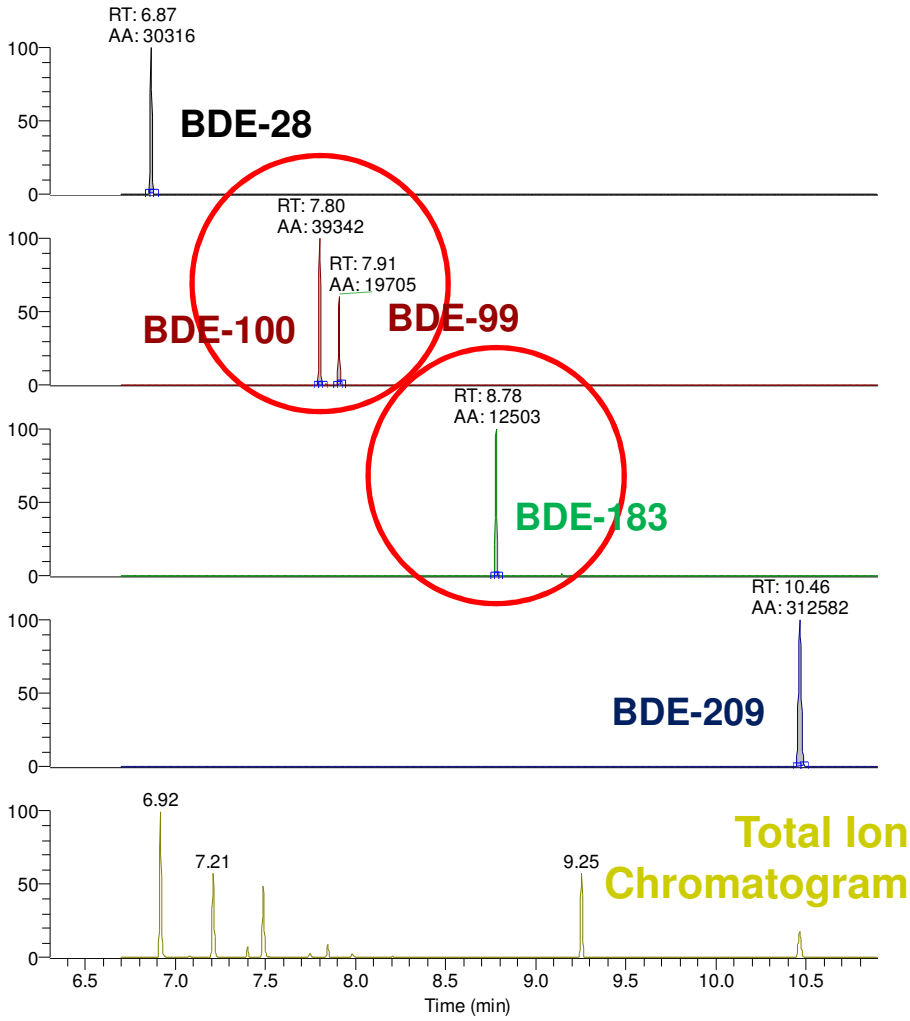
Acquisition modes

TUNA sample spiked with 0,01 ng/g

Full Scan *m/z* 400-1000



SIM 50 Da

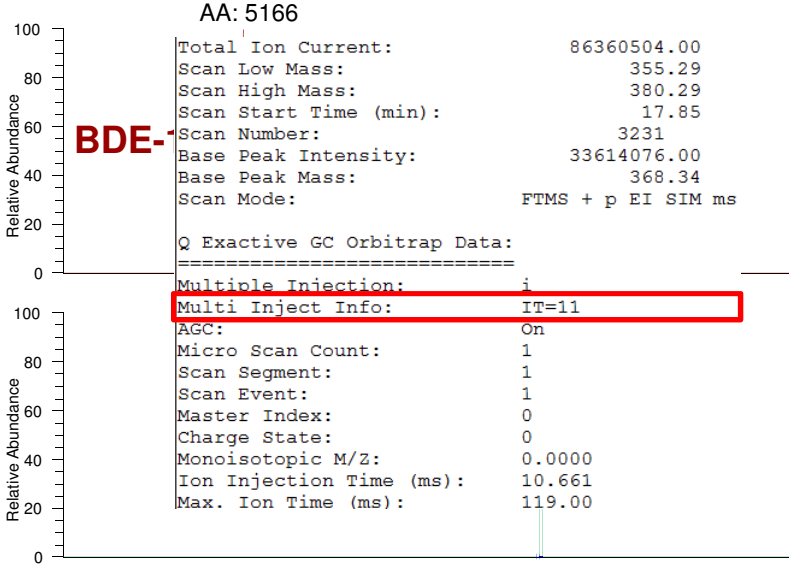


Acquisition modes

TUNA sample spiked with 0,01 ng/g

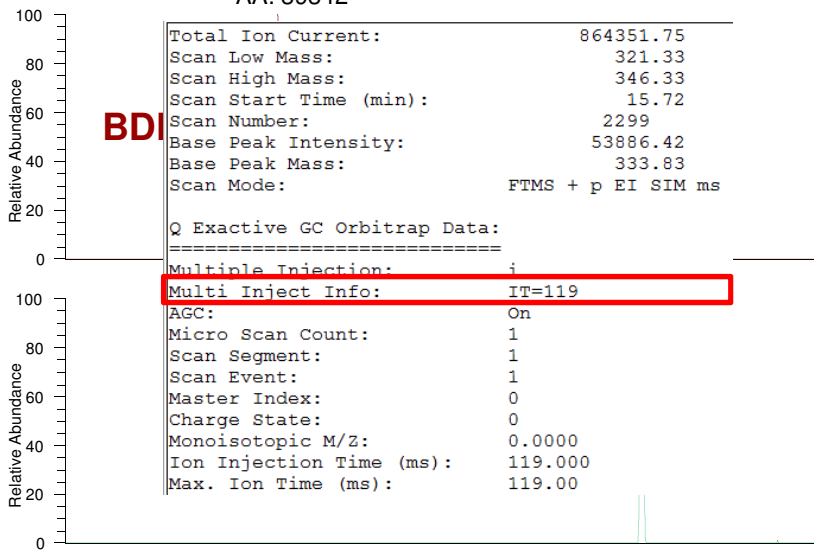
Full Scan *m/z* 400-1000

AA: 5166



SIM 50 Da

AA: 39342



Ion Time: 11 ms

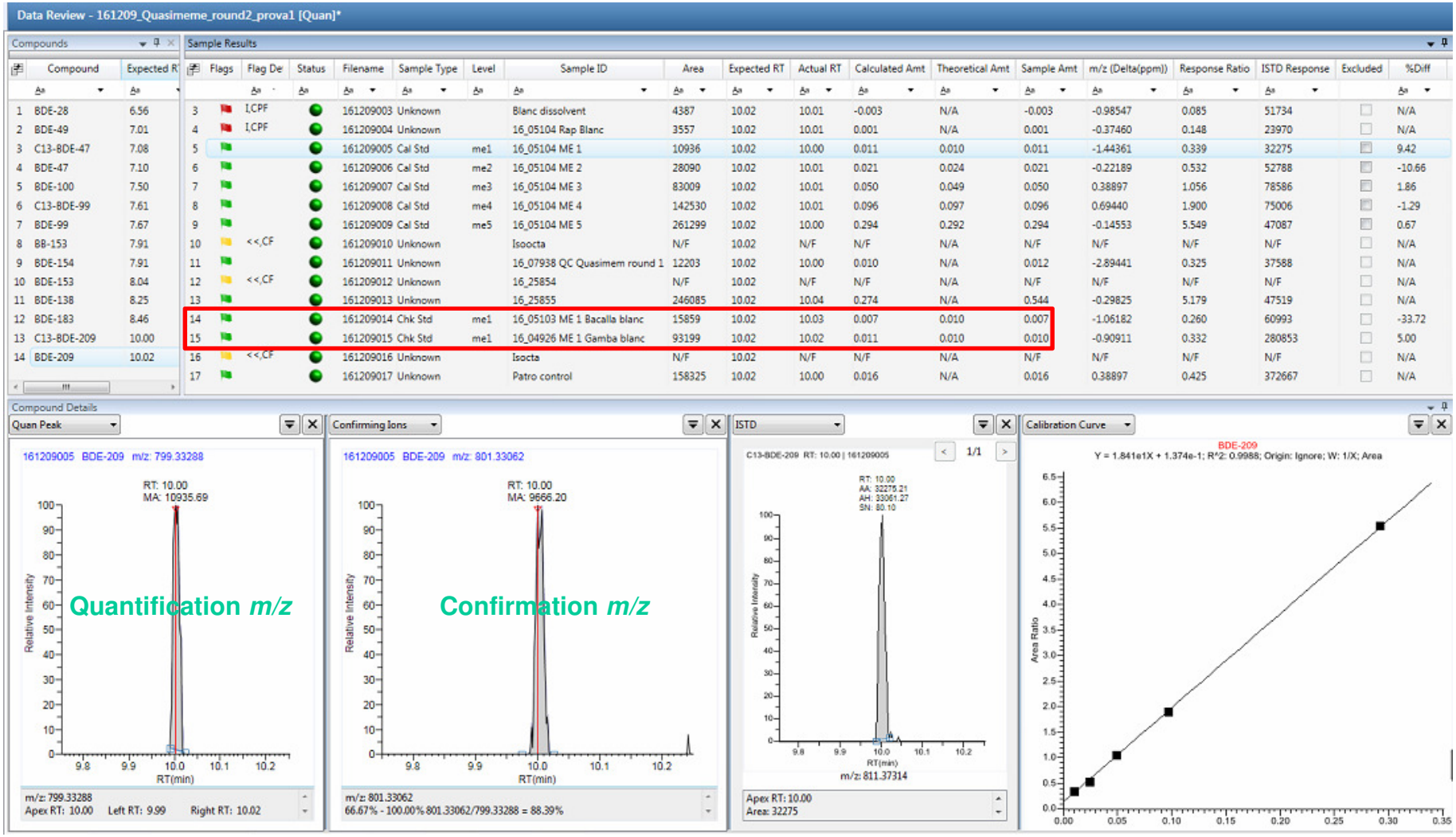
Ion Time: 119 ms

C- trap saturation due to matrix is overcome using the Q!

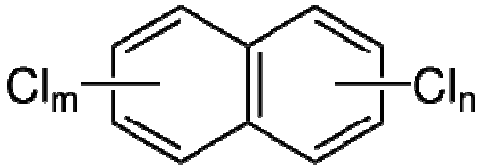
Polybrominated diphenyl ethers (PBDEs)

Monkfish extracted matrix-matched calibration curve
0.01 ng/g to 0.3 ng/g PBDEs

BDE-209



Polychloronaphtalenes (PCNs)



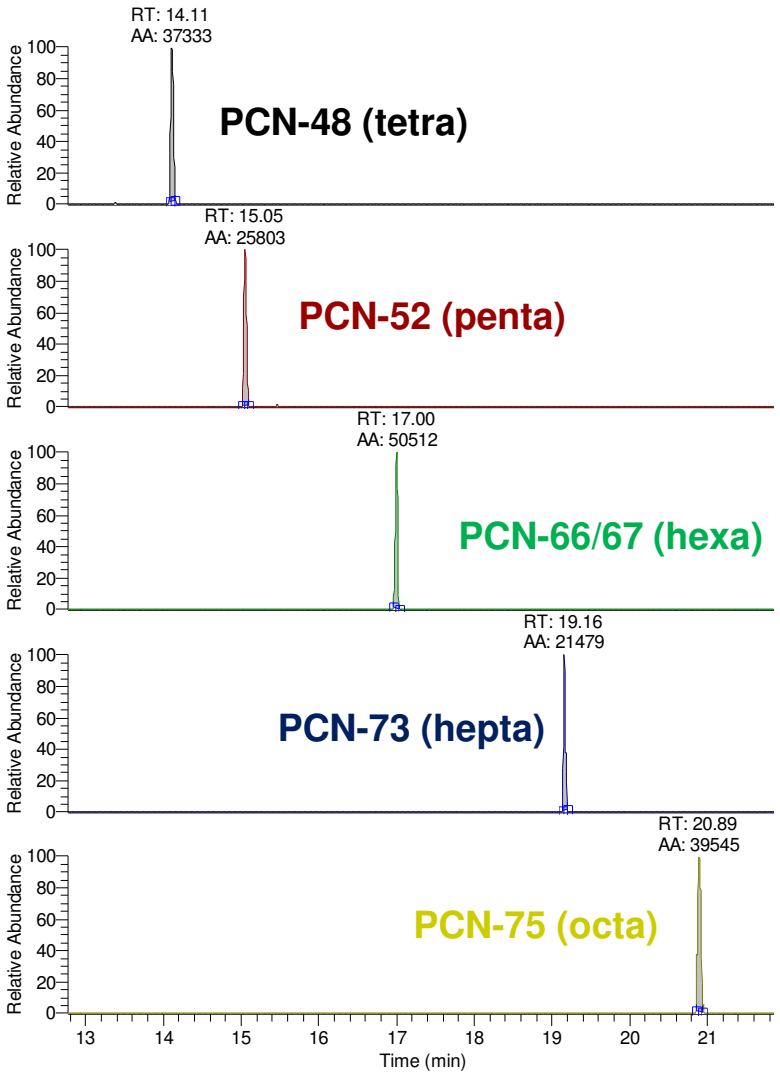
Listed under Annex A and C with specific exemptions for use

Samples analyzed

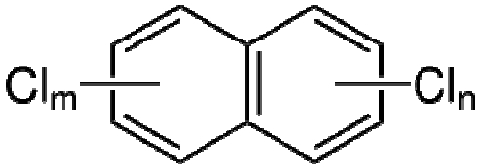
- Fish and seafood
- Eggs and egg products

Instrumental Analysis

- PTV injection
- HP-5MS, 30 m, i.d. 0.25 mm, 0,25 µm GC column
- Optimized Tune parameters
- High Resolution (≥ 60,000 FWHM *m/z* 200)
- Wide SIM: 25 *m/z* window to monitor the whole isotopic pattern
- Mass accuracy < 1ppm
- External calibration



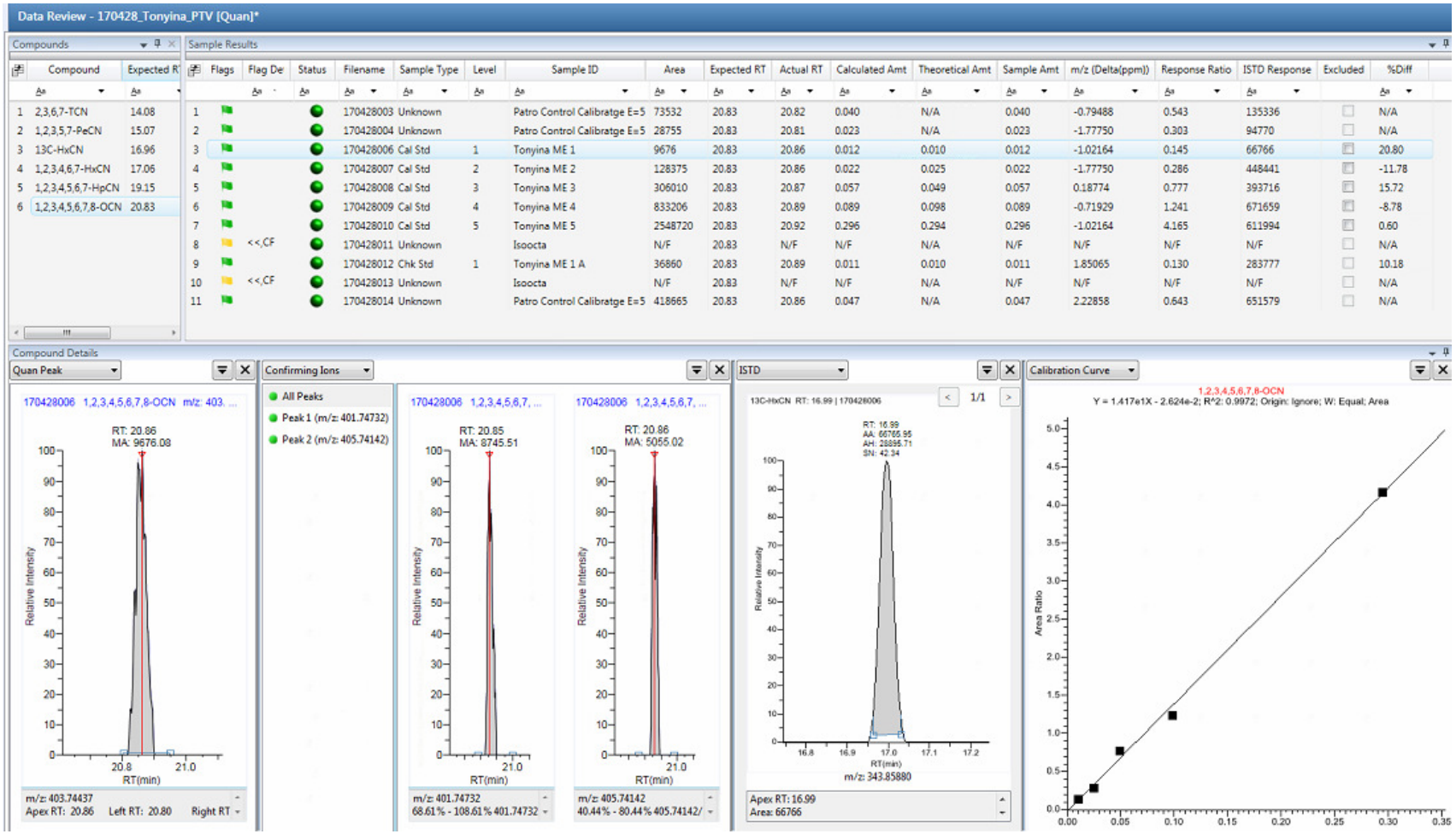
Polychloronaphtalenes (PCNs)



If m=4 and n=4

PCN-75: Octachloronaphthalene

LOQ= 0,01 ng/g wet weight



Quantification *m/z*

Confirmation *m/z*

Non-dl-Polychlorobiphenyls (n-dl-PCBs)

Analytical requirements for the official control of the levels of non-dioxin-like PCBs:

PCB-180

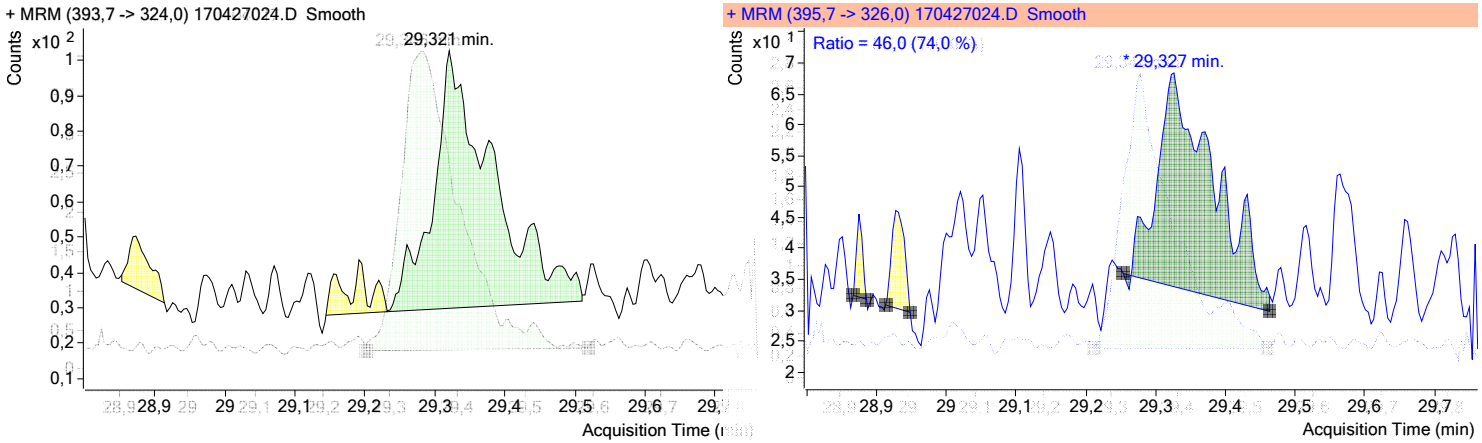
0,08 ng/g wet weight

≥ 0,100 ng/g fat

0,025 ng/g wet weight

≥ 0,031 ng/g fat

GC-MS/MS (QqQ)



6.4.2017 EN Official Journal of the European Union L 92/9

COMMISSION REGULATION (EU) 2017/644

of 5 April 2017

laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs and repealing Regulation (EU) No 589/2014

3. **Demonstration of performance of method:**

Validation in the range of the maximum level (0,5 to 2 times the maximum level) with an acceptable coefficient of variation for repeated analysis (see requirements for intermediate precision in point 8).

4. **Limit of quantification:**

The sum of the LOQs (2) of non-dioxin-like PCBs shall not be higher than one-third of the maximum level (3).

5. **Quality control:**

Regular blank controls, analysis of spiked samples, quality control samples, participation in interlaboratory studies on relevant matrices.

Ndl-Polychlorobiphenyls (Ndl-PCBs)

Analytical requirements for the official control of the levels of non-dioxin-like PCBs:

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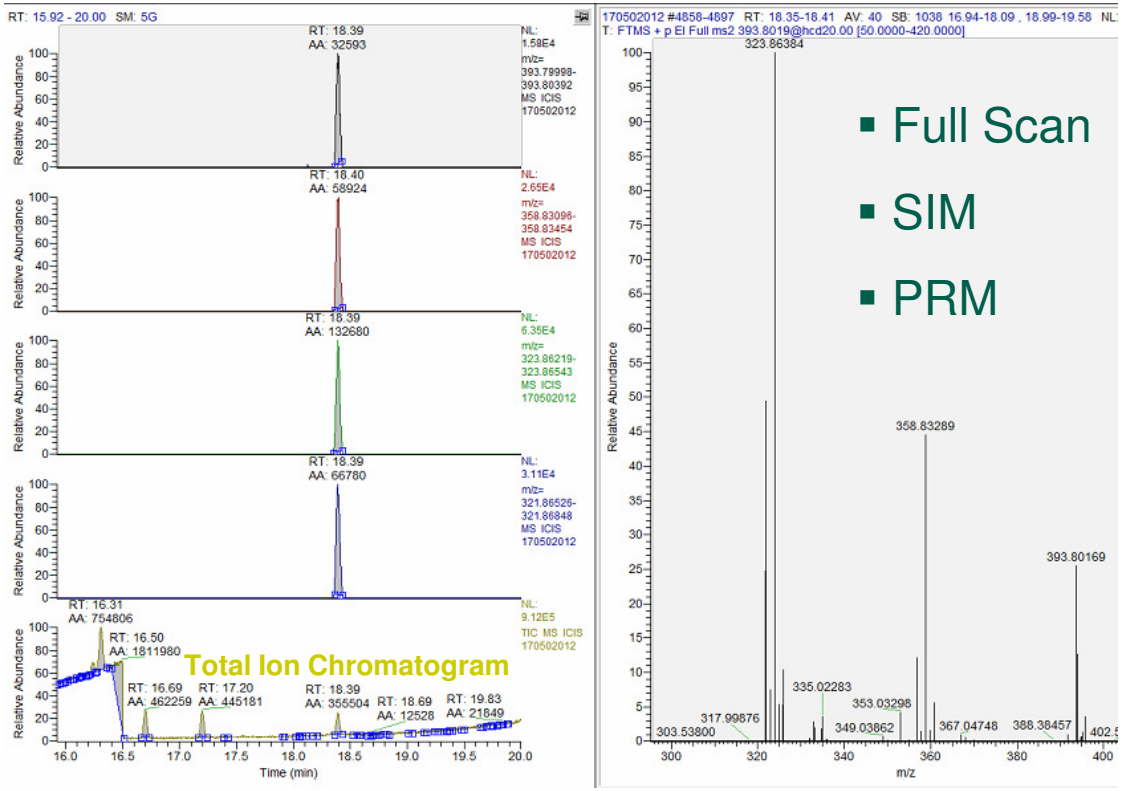
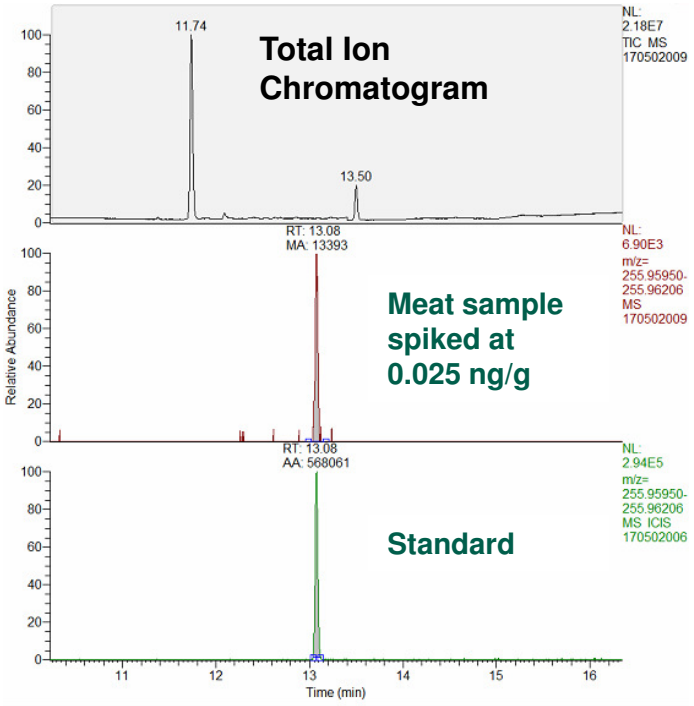
laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs and repealing Regulation (EU) No 589/2014

PCB-180



- Full Scan
- SIM
- PRM

PCB-28



Conclusions

GC-Orbitrap is a useful tool for control labs:

- outstanding sensitivity
- high selectivity when analyzing complex matrices
- high robustness
- helps to fulfill new Regulations with extremely low limits (e.g. PBDEs)
- helps to confirm doubtful results

But some expertise and optimization of instrumental parameters is needed.

Thanks for your attention

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