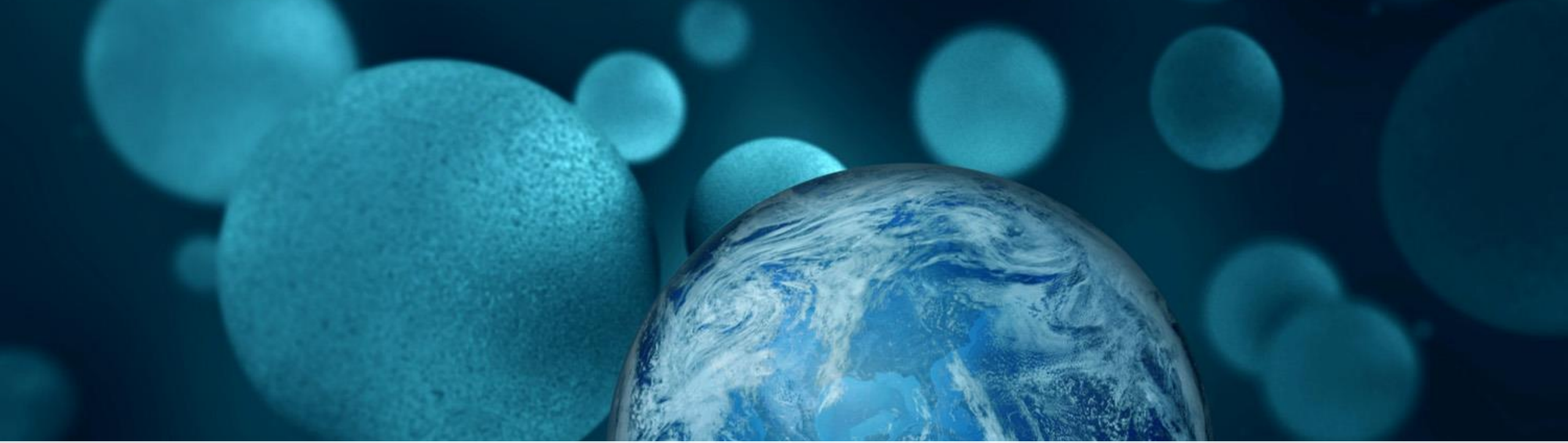

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Emerging applications in routine mass spectrometry

Michal Godula
Special Solutions Center
Thermo Fisher Scientific

Where do we go?

Sample

How much of a compound?

What analytes are present?

What is different?

Targeted Acquisition

FullScan Approaches – Non Targeted Acquisition

Triple Quadrupole MS/MS

Tribrids
Fusion Lumos

Single Quadrupole MS/MS

Q Exactive Family

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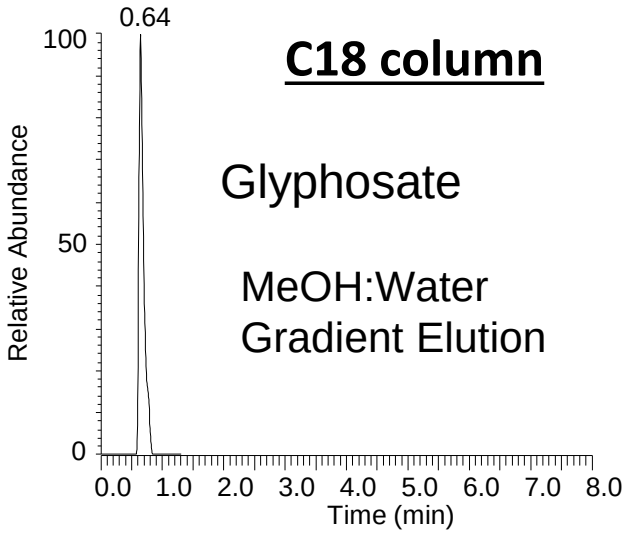
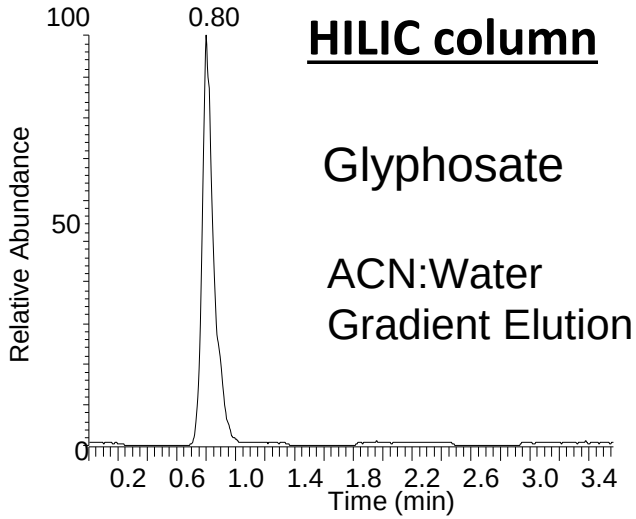
Chromatography is Important….Glyphosate Story



C18 column

Glyphosate

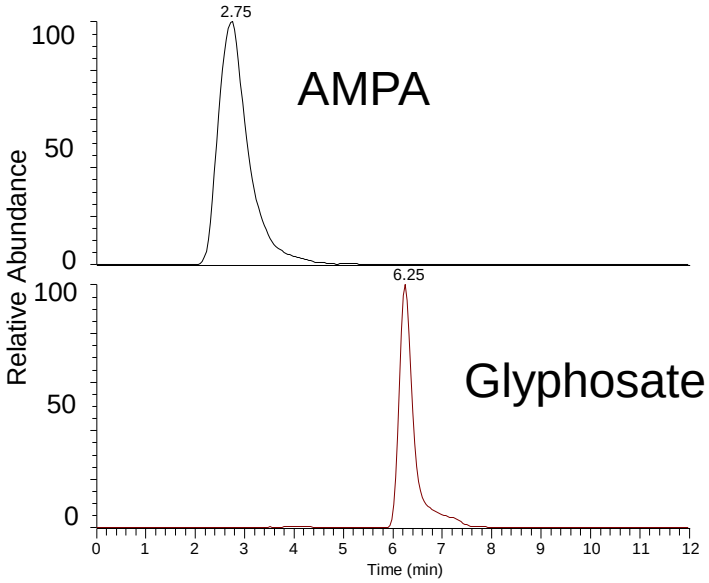
MeOH:Water
Gradient Elution



HILIC column

Glyphosate

ACN:Water
Gradient Elution



Mix-mode: HILIC + Ion-Exchange

ACN:0.1%HCOOH
600 µL/min

HPLC-MS/MS Approach – demanded by users but difficult

IC-MS/MS needs to be used to deliver good performance!

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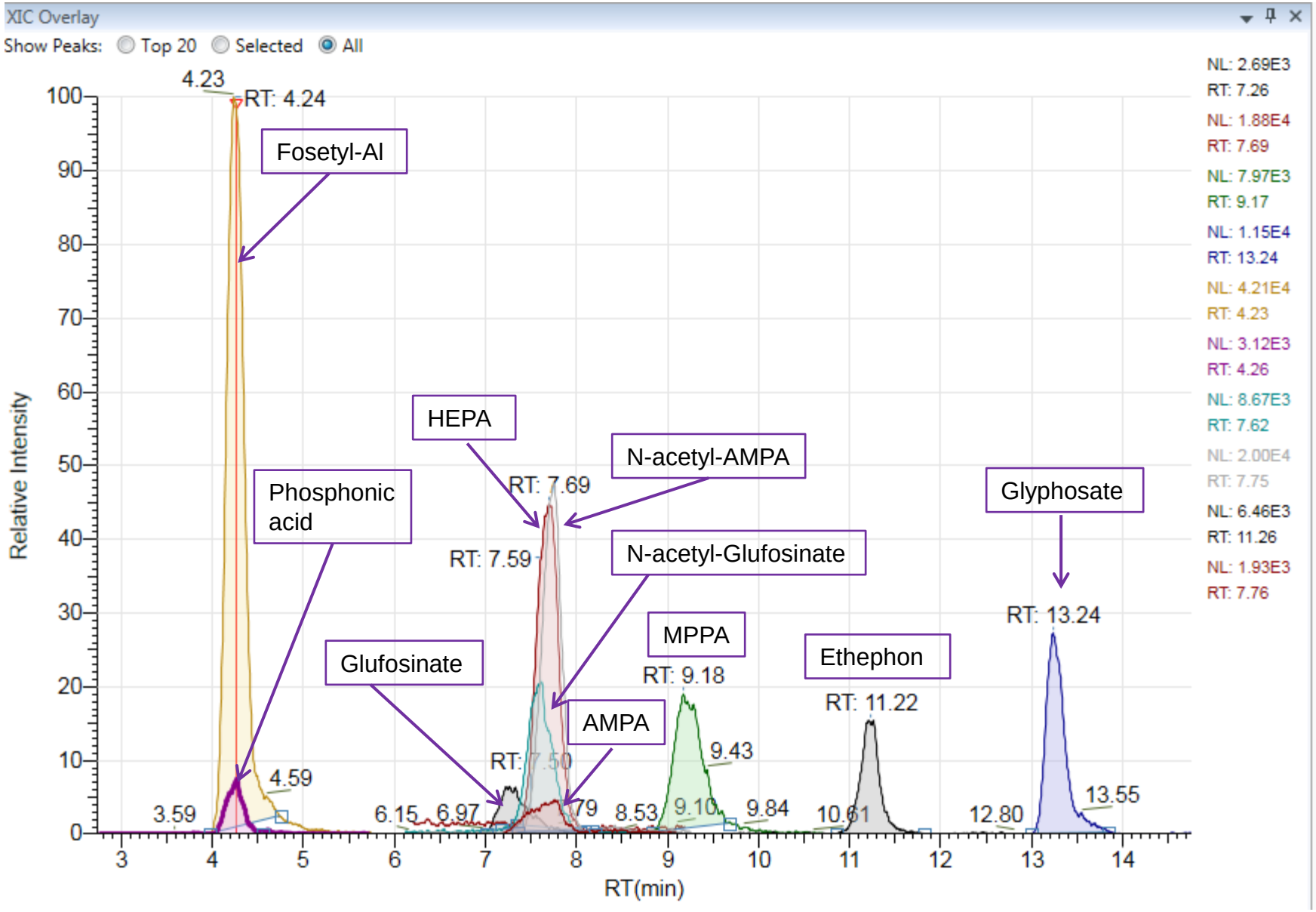
IC-MS/MS Chromatogram of polar pesticides in lettuce at 10 ug/kg



Thermo Scientific™ Integrion™ IC with TSQ Quantis™ MS/MS

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Glyphosate analysis in water at ng/l levels

Name	LOD [ppt]	LOQ [ppt]	RSD % (10 ppt) level
Fosetyl-Al	1	2.5	5
Clopyralid	10	50	9
AMPA	2	5	9
Glyphosate	5	10	15
Glufosinate	2	5	4

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Total Fipronil and Fipronil Sulfone Analysis Workflow Options

Easy and fast sample preparation

Thermo Scientific™ UltiMate3000™ RSLC with Thermo Scientific™ TSQ Quantis™ MS

Thermo Scientific™ TRACE™ 1310 GC with Thermo Scientific™ TSQ™ 8000 Evo triple quadrupole GC-MS/MS

Thermo Scientific™ TraceFinder™ 4.1 data processing software

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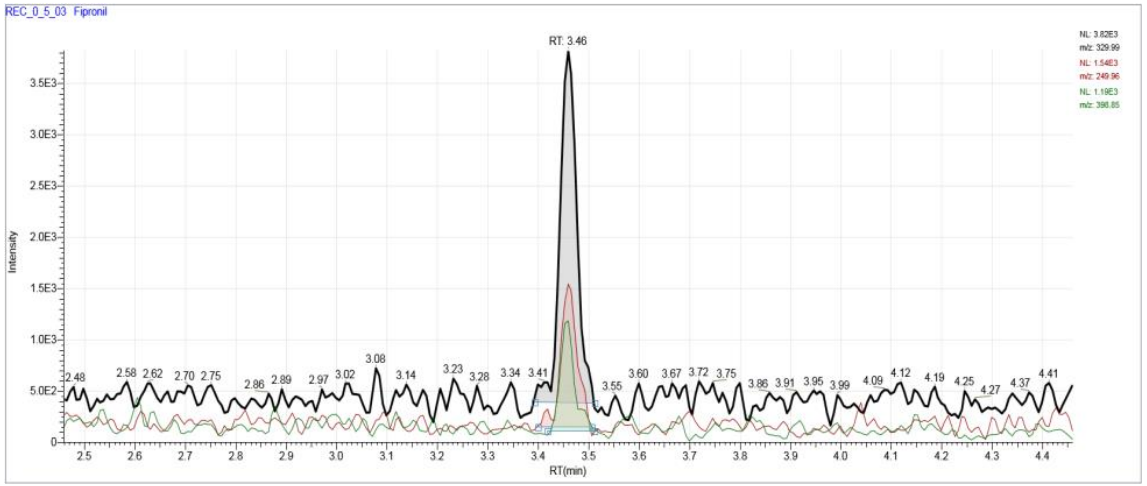
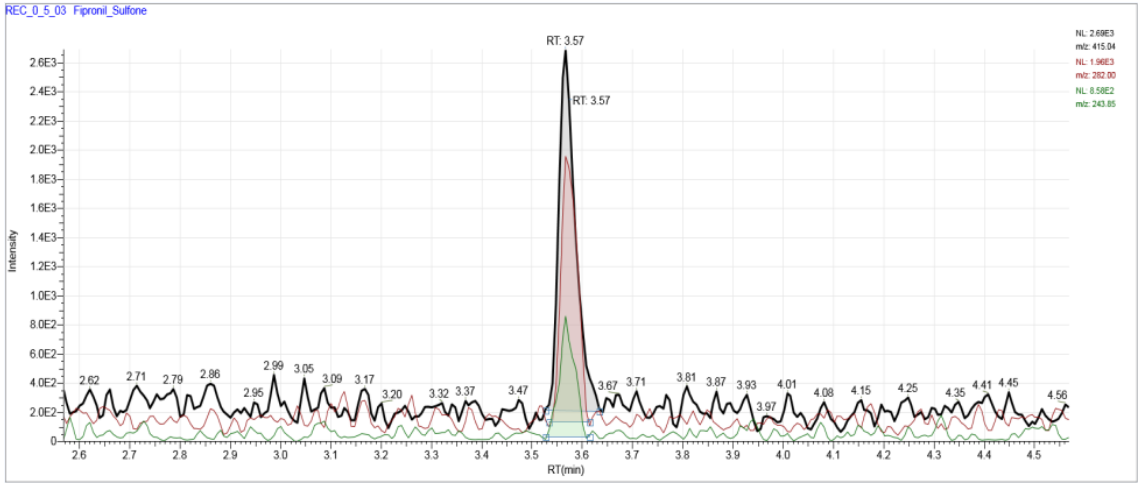
Results: Quantitative and Qualifier Ions (UHPLC-MS/MS)

Fipronil: 0.5 µg/kg



Fipronil sulfone: 0.5 µg/kg



https://www.thermofisher.com/cz/en/home/industrial/food-beverage/food-beverage-learning-center/food-analytical-testing-information.html

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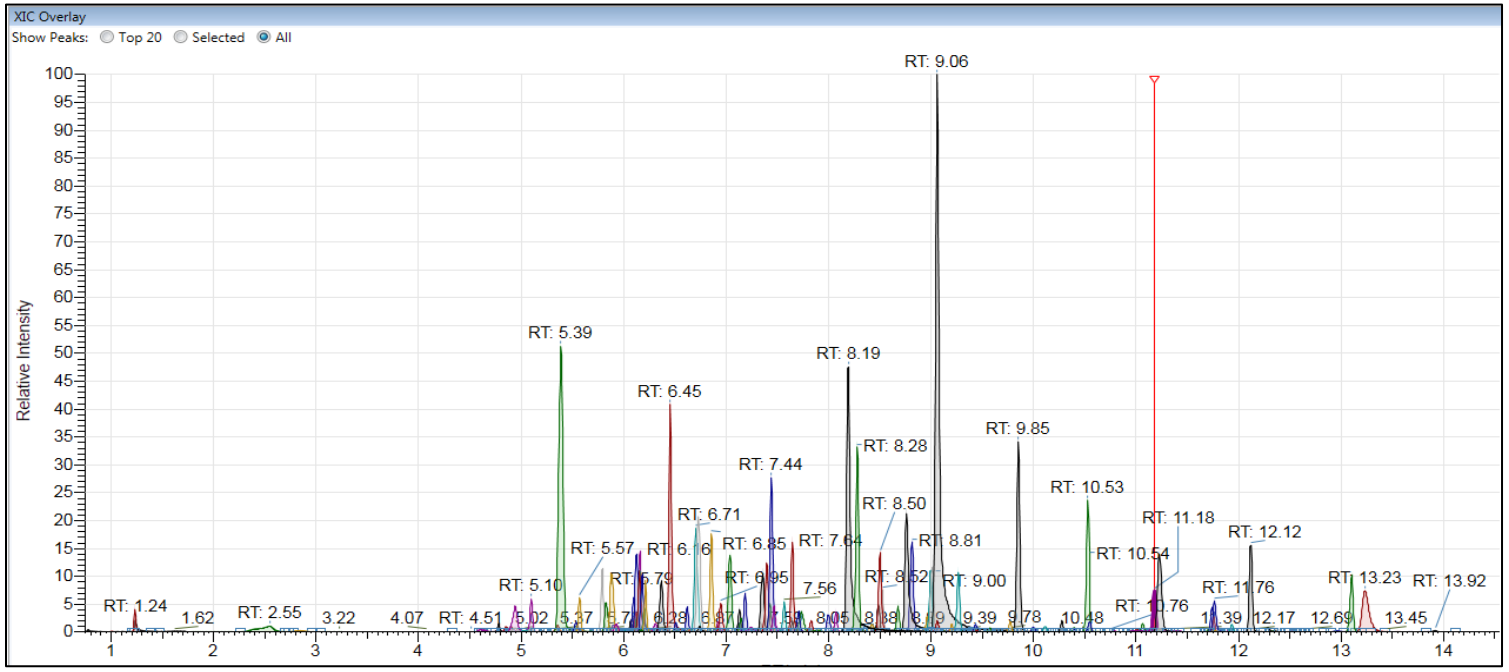
Multi-Residue method for veterinary medicine residues with TSQ Altis

- 150+ compounds included in the method for the following classes of veterinary medicines:
  - Cefalosporins, macrolides, penicillins, quinolones, sulfas, tetracyclines, anthelmintics, nitroimidazoles, NSAIDs, sedatives, avermectins and coccidiostats, dyes (applied to fish), steroids (milk)



- QuEChERS based approach
  - EDTA/NH_4 oxalate solution and acetonitrile added to sample
  - Sample homogenised until sample fully dispersed
  - Sodium sulphate added before centrifugation
  - Dispersive SPE (CEC- C_{18}) clean-up
  - Add 1 mL H2O to 3mL extract, filter, inject

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Benefits of Orbitrap Mass Spectrometry (HRAM)

- **Non-targeted acquisition**:
  - Same sensitivity as triple quadrupole
  - Increase the scope of the analysis through full-scan
  - Simple full-scan acquisition
  - Perform targeted live or retrospective data processing

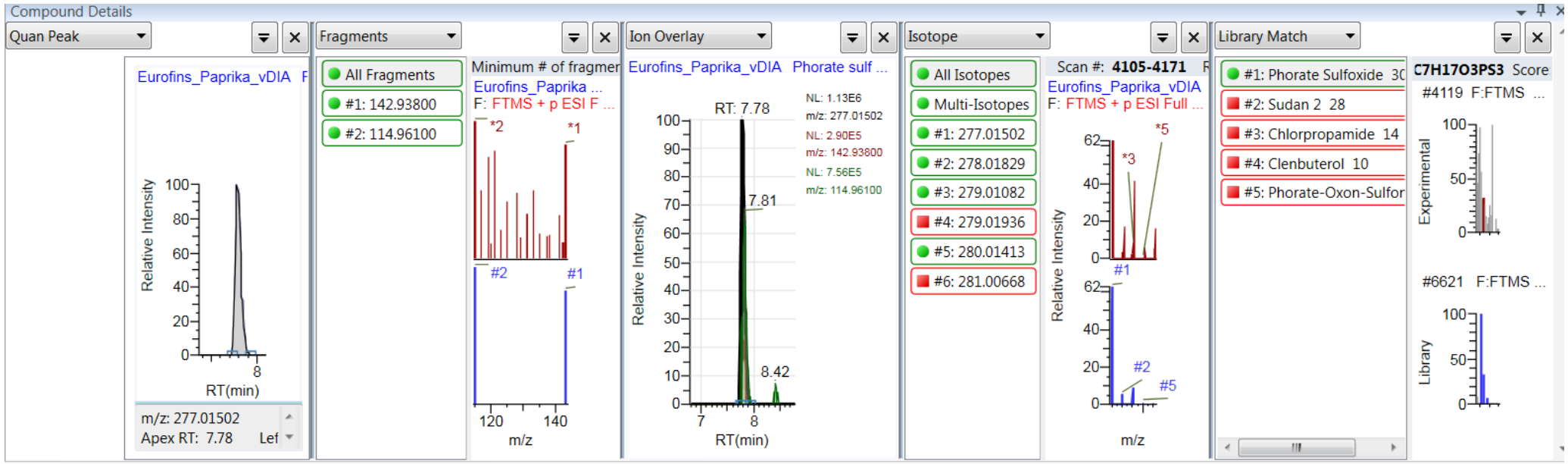
SANTE/11945/2015 **Screening, identification, quantitation** and **confirmation requirements**
QqQ: 2 SRMs (Quan and Qual), Ion ratios, Peak characteristics
HRAM: defined and can be applied (<5ppm, >2 fragment ions)

Solution
1. **Screening , quantitation and identification** by Q Exactive, ideally **FullScan/(vDIA)** to provide chromatographic profile of at least 2 HRAM ***ions***

2. **Confirmation** with Q Exactive **FullScan/ddMS2** to provide MS2 spectra

Screening Example – Acetamiprid in honey sample

Possible identification parameters



1) Accurate mass
2) at given retention time (tr)

3) Fragment ion presence (min. 1) at given tr

(For ddMS)

4) Confirmation ions' presence
5) Ion ratio

(For vDIA)

6) Isotopic pattern

7) Library match

Acceptance criteria: accurate mass at correct Rt + presence 1 additional identification parameter

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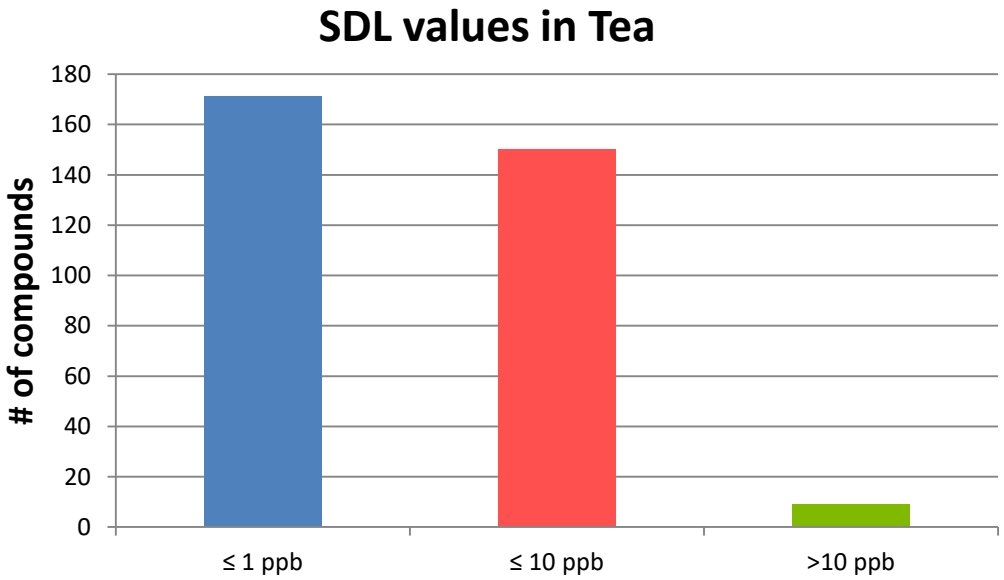
Results of vDIA – Sensitivity in Tea, 1 ul injection on column!

- Screening Detection Limits – Tea matrix



SUM = 330 compounds

321 compounds SDL ≤ 10 µg/kg

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Keywords
Q Exactive Focus, Vanquish Flex, QuEChERS, pesticide residues, vDIA

Goal
To develop and test a multi-residue instrumental method that can be applied for high-throughput screening and semi-quantitation of pesticide residues in food matrices at or below the current legislative requirements. A high-resolution, accurate-mass mass spectrometer operated in Full Scan – Variable Data-Independent Analysis (FS-vDIA)* mode providing an option for full spectrum filtering, retrospective analysis, and multi-parameter-based compound identification was applied. The method was validated for 328 target pesticides, with an option for the future extension to a larger number of analytes.

Introduction
European Commission directive EC 396/2005 sets maximum residue levels for pesticides in different products of plant and animal origin. The regulation presents significant analytical challenges with respect to the low limits of quantification and high number of target analytes. Nowadays, many GC- and LC-based methods are in routine use employing mostly low-resolution triple quadrupole mass spectrometric detection.

*vDIA method is not available in the United States of America.

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vDIA method not available in the United States of America

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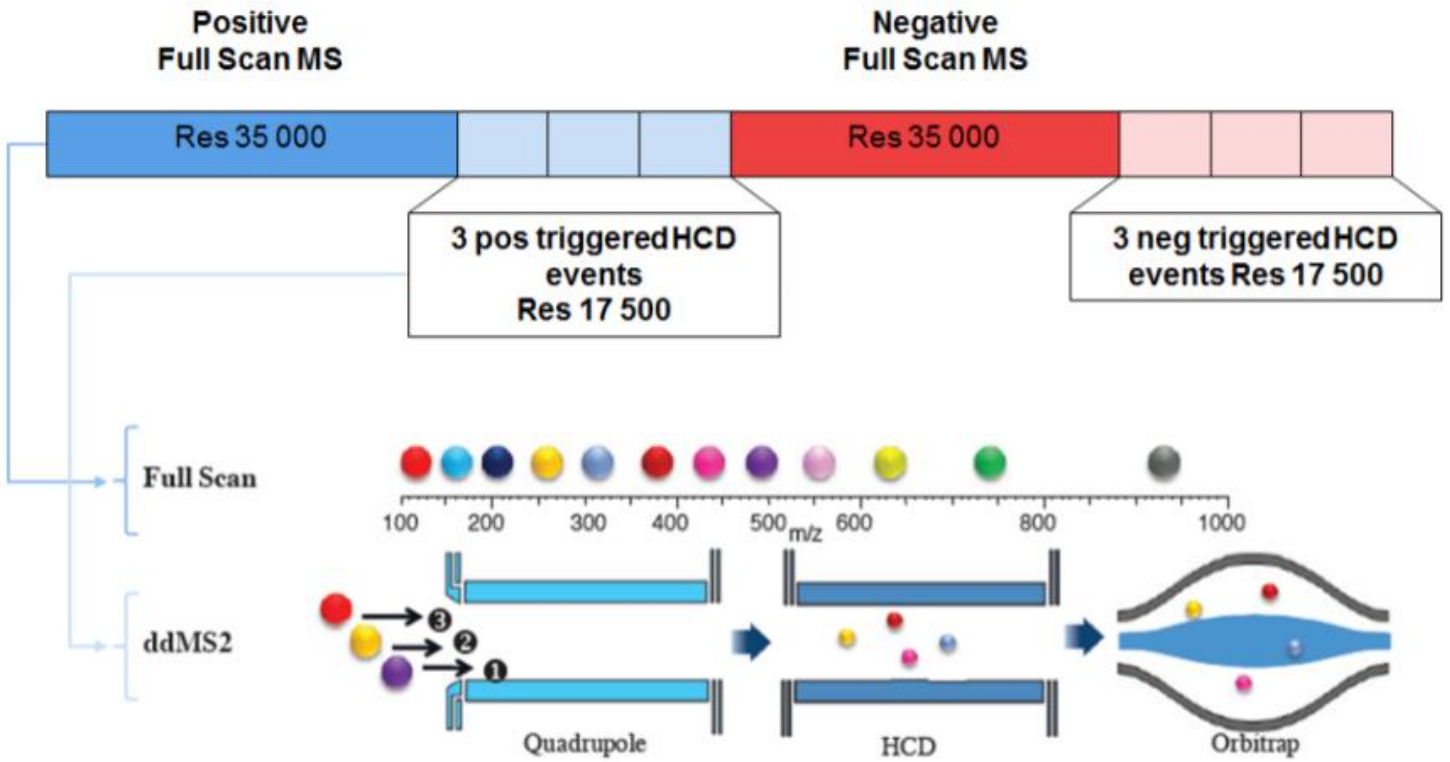
Forensic Toxicology/Doping/Drugs of Abuse with ddMS2 workflow



- Turboflow TLX-1 with Q Exactive Focus
- Compound Database with >1500 compounds
- Pos/Neg in one run
- Online Extraction – total run time 16.5 min

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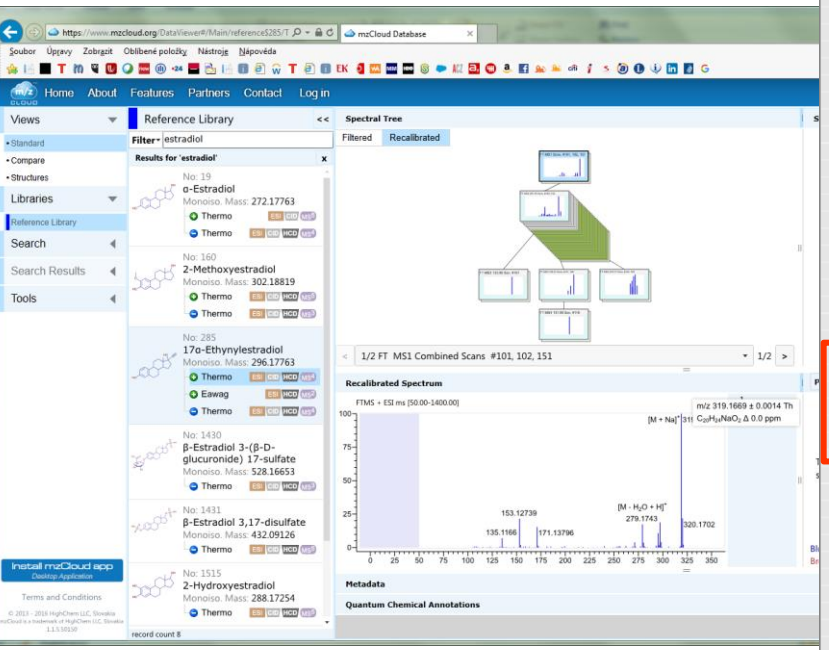
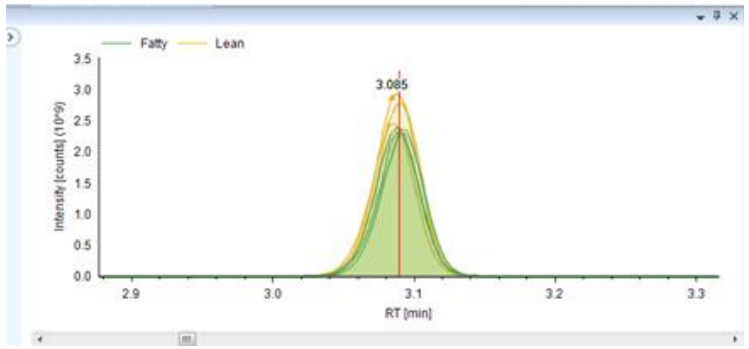
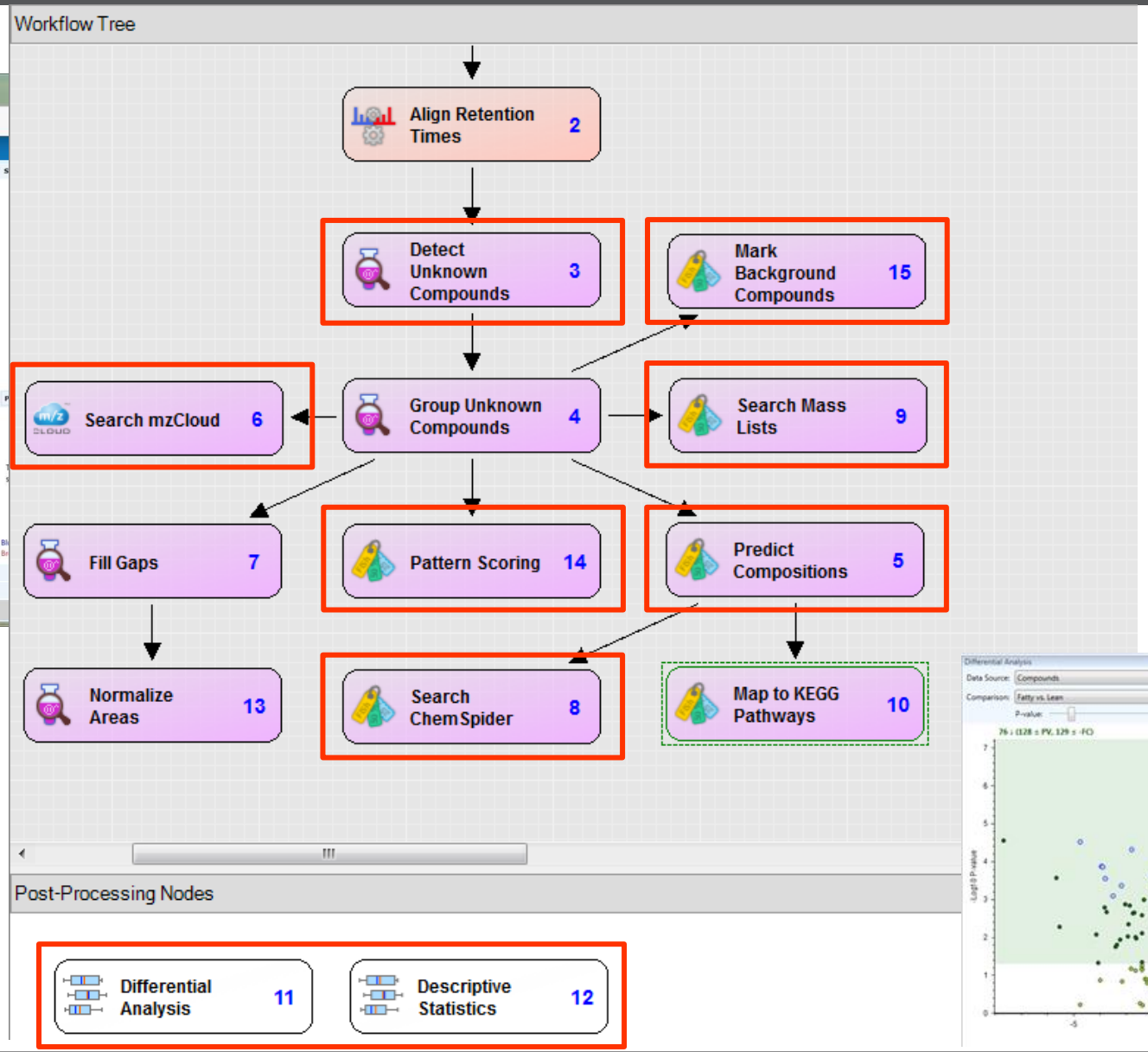
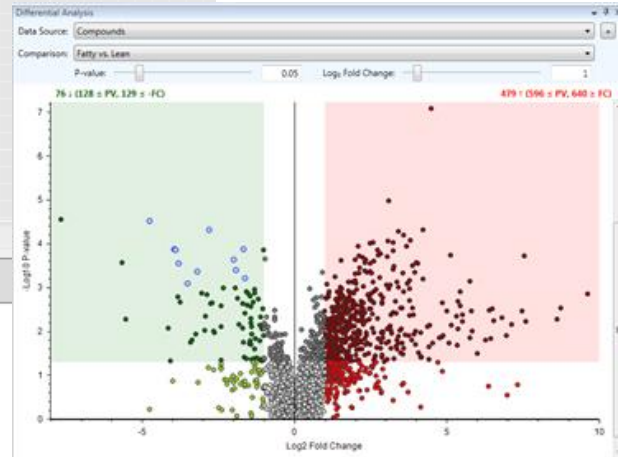
Unknown Workflow – What is different? Can I identify the components?









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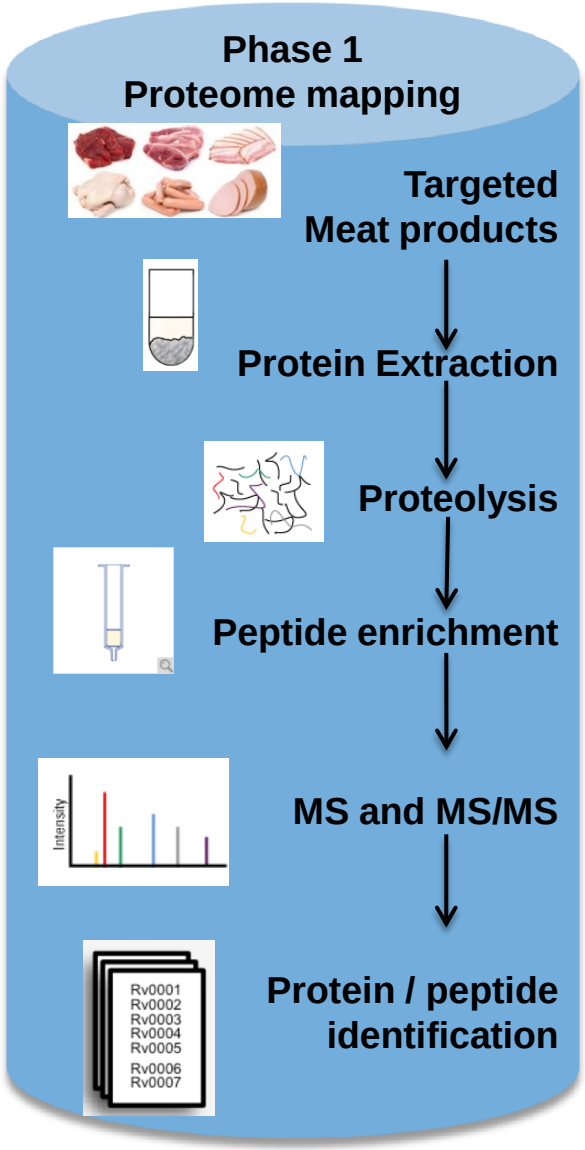
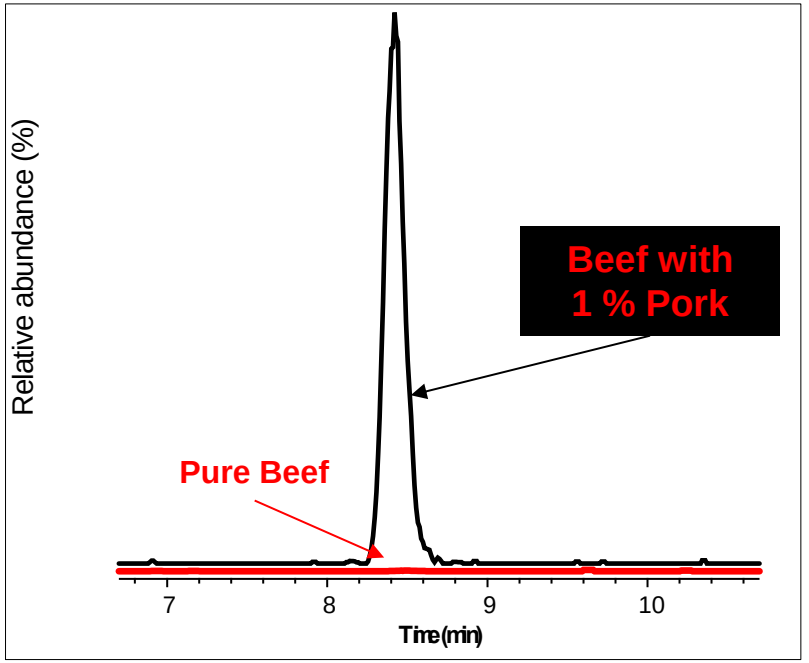
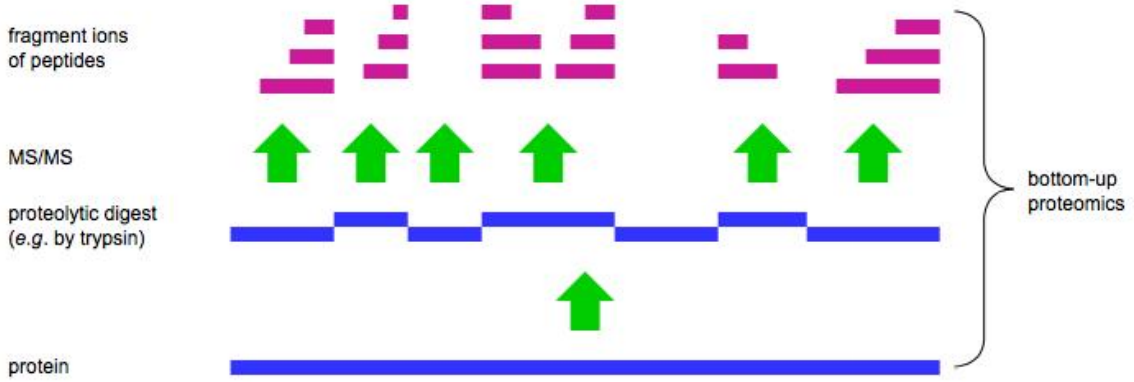
Targeted Bottom-Up Proteomics Can Be Used For Meat Speciation







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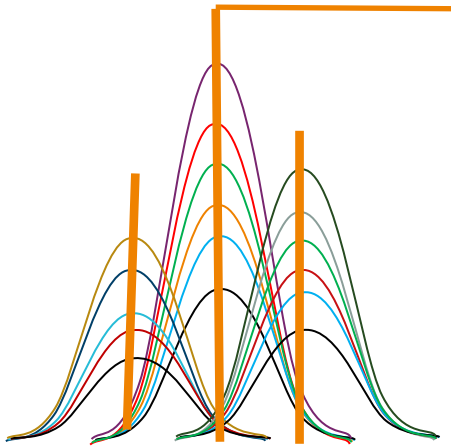
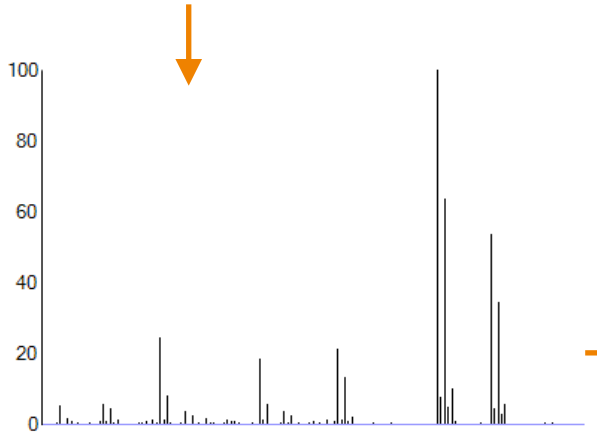
Peak Detection and Candidate Matching with GC Orbitrap EI Spectral Acquisition

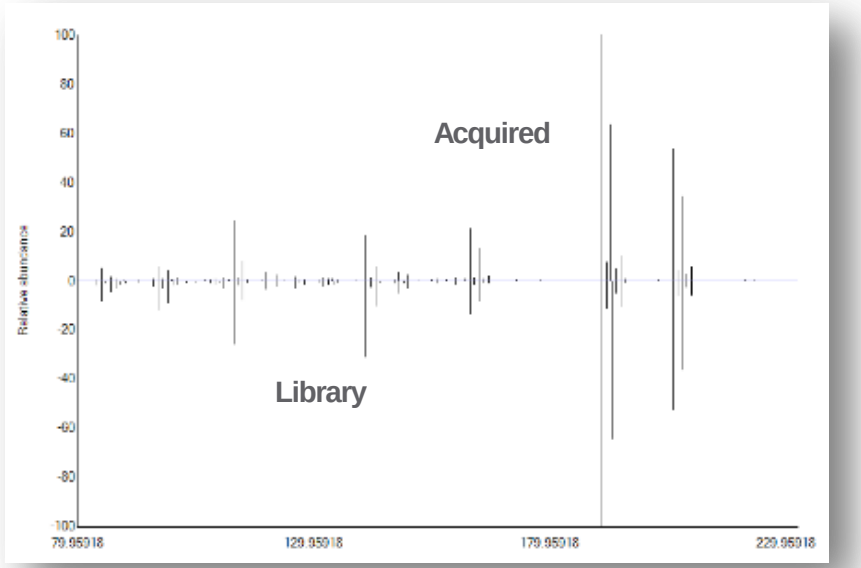
Full scan analysis



Deconvolve TIC

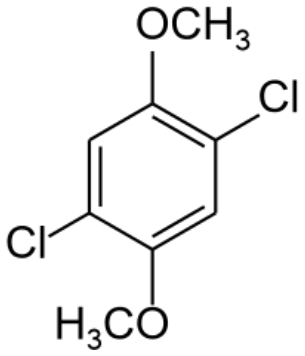


Create “clean” spectrum



Library search

Candidate Compounds



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What is the future of MS applications?

- Right chromatography
- Total Workflows for LC-MS and GC-MS based applications
- Utilization of high resolution and accurate mass MS for screening, identification and quantification AND confirmation
- Merging of omics approaches with targeted methods – allergens, proteins
- Authenticity and adulteration
- Novel data processing software tools – Compound Discoverer
- You!

Blagodarja!

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