IMPLEMENTATION OF AUTOMATED SAMPLE EXTRACTION USING EXTREVA ASE

JOSÉ ANTONIO MARTINEZ MARTINEZ
EURL-FV
UNIVERSITY OF ALMERIA

FUNDAMENTALS OF PRESSURIZED LIQUID EXTRACTION

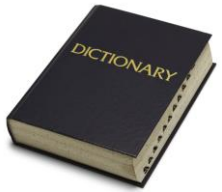
Implementation of automated sample extraction using PLE

PLE (Pressurized Liquid Extraction)

- PLE is a solid-liquid extraction, PLE uses solvent extraction at high temperatures (40-200ºC) and pressures (10-15Mpa), always below their respective critical points, so that the solvent remains liquid during the extraction process

- This technique is known as:

- **ASE**: accelerated solvent extraction
- **PFE**: Pressurized fluid extraction
- **PHSE**: Pressurized hot solvent extraction
- **HPSE**: High-pressure solvent extraction
- **HPHTSE**: high-pressure high-temperature solvent extraction
- **SSE**: subcritical solvent extraction



Implementation of automated sample extraction using PLE

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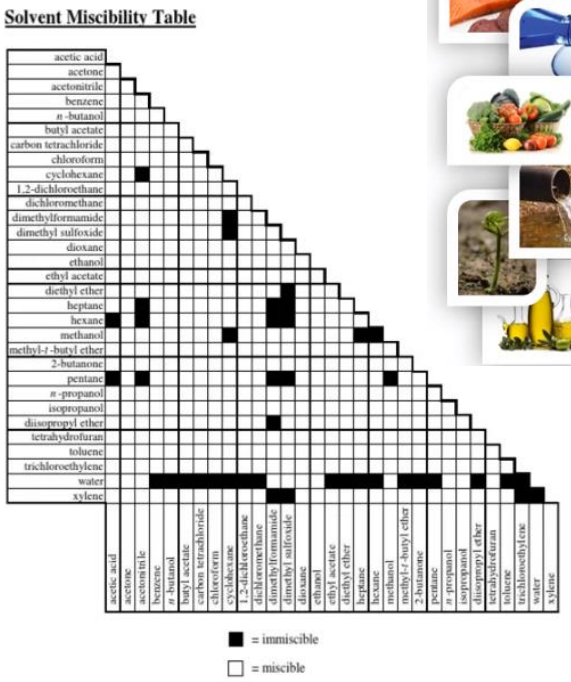
- PLE is a solid-liquid extraction, PLE uses solvent extraction at high temperatures (40-200ºC) and pressures (10-15Mpa), always below their respective critical points, so that the solvent remains liquid during the extraction process

- As a result of using these pressure and temperature conditions, a change in the physicochemical properties of the solvent occurs. For example, mass transfer rates are improved, while, at the same time, the surface tension and viscosity of the solvent decrease and the solubility of the analytes increases. This allows the solvent to penetrate more easily and more deeply into the solid matrix being extracted. As a result, significantly higher extraction yields are obtained compared to conventional extractions (sonication and soxhlet extraction)

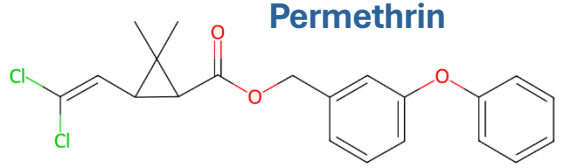
Implementation of automated sample extraction using PLE

PLE (Pressurized Liquid Extraction)

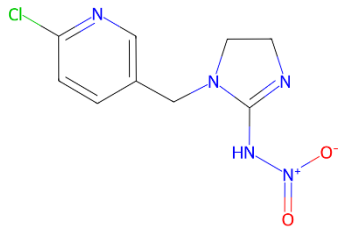
- The choice of a wide range of solvents makes PLE a versatile technique
- The solvent should be selected considering the nature of the compounds to be extracted (analytes) and the chemical composition of the sample



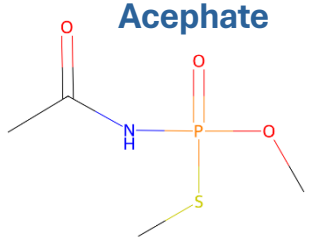
Permethrin



Imidacloprid



Acephate



Implementation of automated sample extraction using PLE

PLE (Pressurized Liquid Extraction)

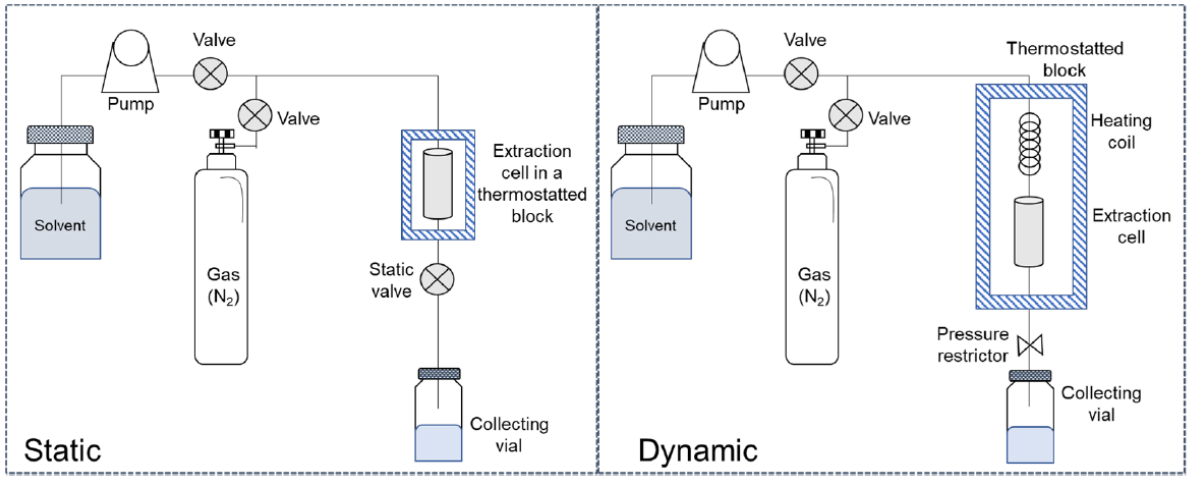
- The main mode of work are two static and dynamic

- In static mode, the extraction solvent is not continuously replaced, but if more than one extraction cycle is used, the solvent is partially or completely replaced after some time

- In the static extraction mode, an equilibrium can be established between the compounds that are still bound to the matrix and the liquid phase in which the analytes are already solubilized

- Thus, the efficiency of the extraction procedure will not increase beyond this point and degradation of some compounds and undesirable chemical reactions may occur more easily. It is therefore important to carefully optimize the static extraction time

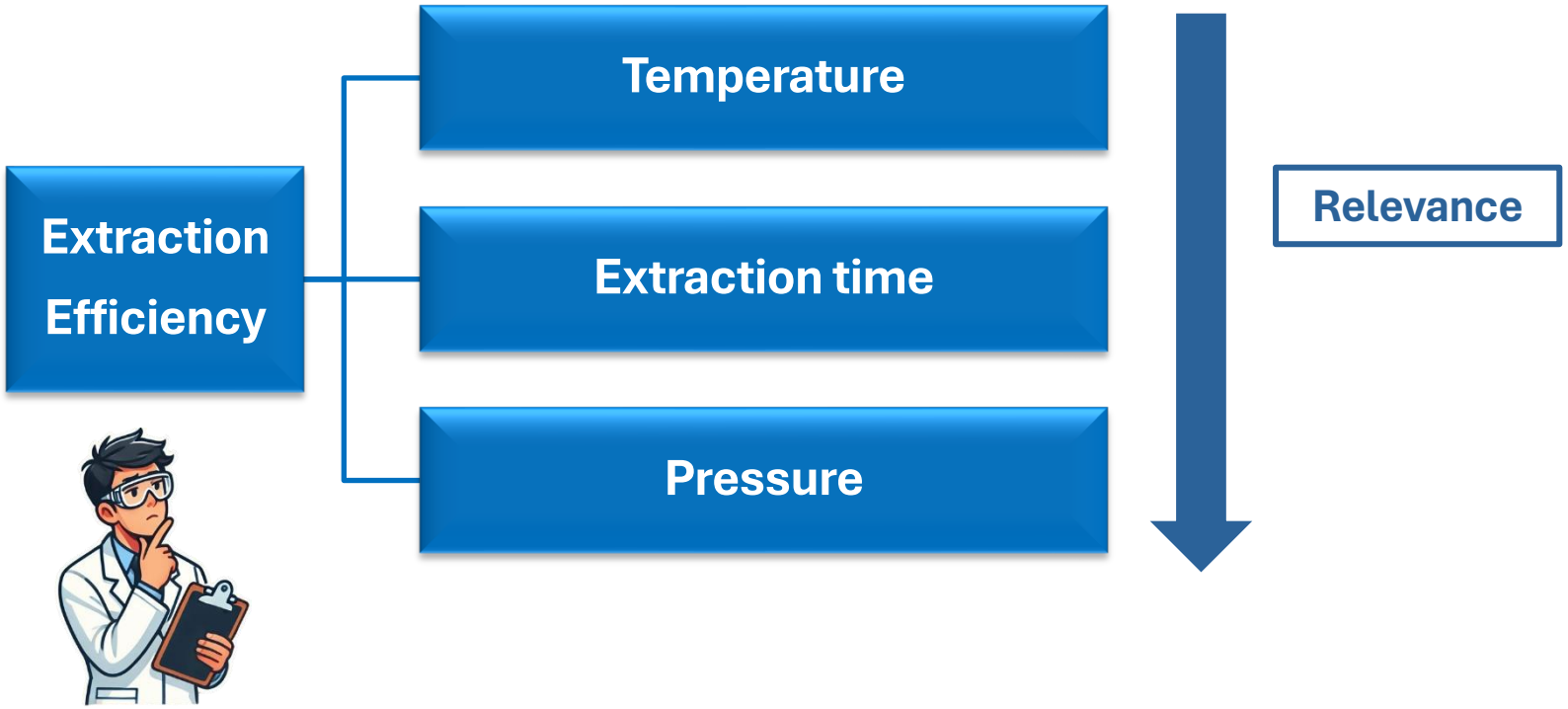
Most used extraction mode



Implementation of automated sample extraction using PLE

PLE (Pressurized Liquid Extraction)

- The parameters to be carefully considered are:

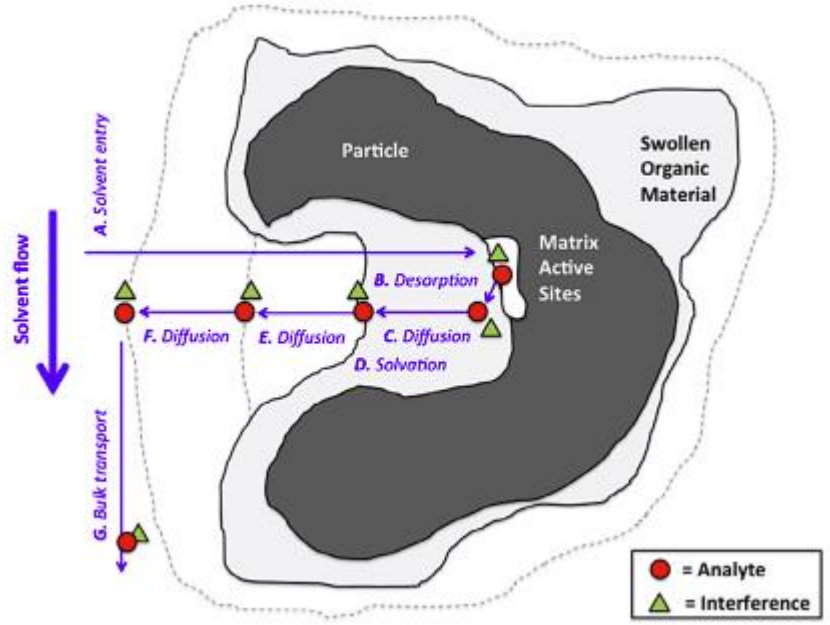


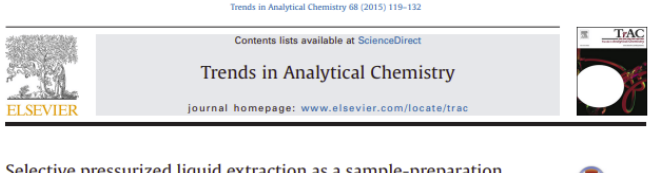
Implementation of automated sample extraction using PLE

PLE (Pressurized Liquid Extraction)

➢ The process of extracting analytes from semisolid and solid samples can be described by the following five steps:

1) Moistening the sample (analytes to be extracted and matrix) with extraction solvent
2) Desorption of compounds from the matrix (including or not the breakdown of chemical bonds)
3) Solvation of the compounds in the extraction solvent
4) Dispersion of the compounds out of the matrix
5) Diffusion through the nearest solvent layer around the matrix to finally reach the bulk solvent

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Selective pressurized liquid extraction as a sample-preparation technique for persistent organic pollutants and contaminants of emerging concern

Bikram Subedi [a,1], Lissette Aguilar [b], Eleanor M. Robinson [b,2], Kimberly J. Hageman [c], Erland Björklund [d], Rebecca J. Sheesley [c], Sascha Usenko [a,b,c,e]

TEMPERATURE

- Temperature affects the physic-chemical properties of the solvent
- It affects mass transfer properties, changing the surface tension, diffusivity and viscosity of the solvent. In this sense, surface tension and viscosity decrease, while diffusivity increases with increasing solvent temperature.
- All these changes in solvent properties resulting from an increase in temperature allow for faster mass transfer and improved sample wetting. In addition, desorption of the analyte from the matrix into the solvent is promoted at higher temperatures, as the intermolecular interactions binding the analyte to the matrix are reduced

(40-200ºC)

EXTRACTION TIME

- The extraction time in PLE is defined as the time during which the solvent is in contact with the matrix at the desired pressure, temperature and flow rate
- The extraction time required to completely extract a particular matrix will depend on the matrix, the type of compound and the extraction mode (static or dynamic), the latter being the most critical parameter
- PLE can be performed in continuous flow or in static mode. Different instrument designs are required for each mode

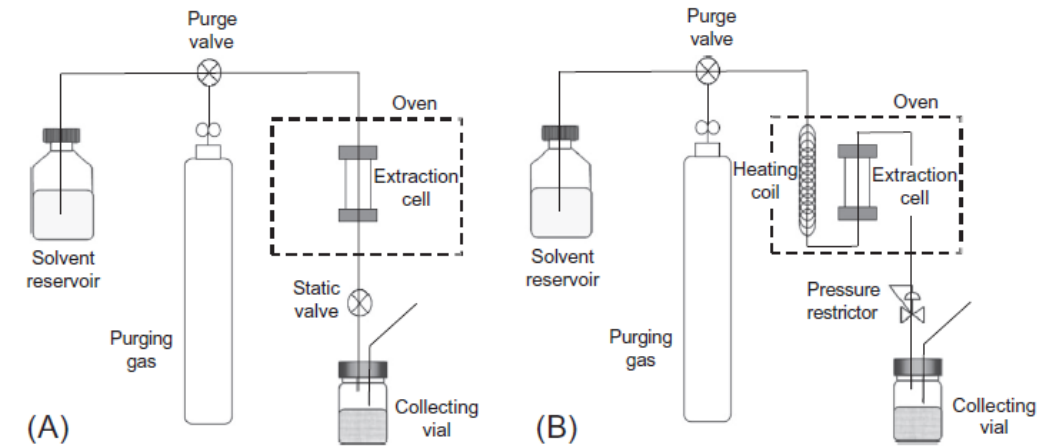
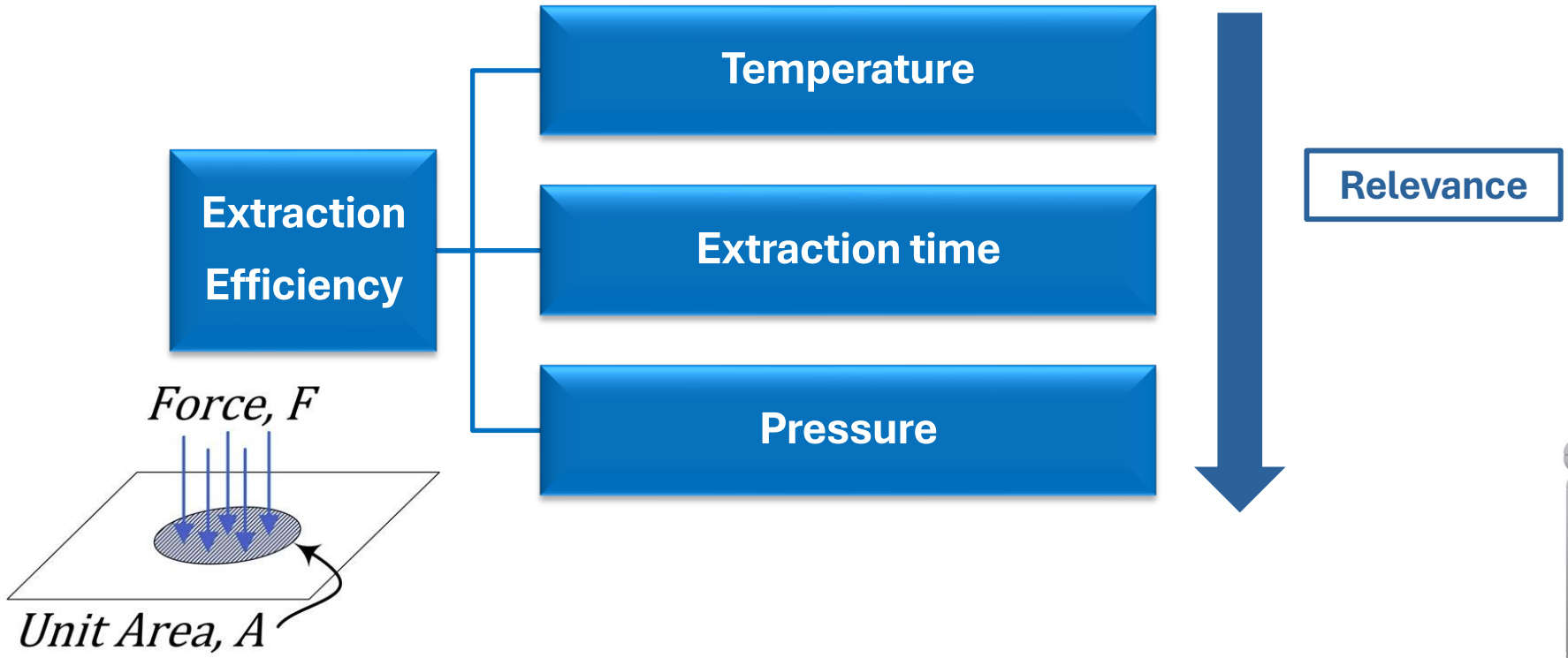


Fig. 13.1 Schematic PLE system. Configurations for development of (A) Static and (B) Dynamic PLE procedures.

Pressure

- Pressure has a limited impact on solvent characteristics as long as the solvent remains liquid. Higher pressure means better wetting of the sample, resulting in better extraction efficiency. Generally, a pressure of 50 to 150 atm is used (in some case less), unless the solvent saturation pressure is used



OTHER PARAMETERS (MATRIX, DISPERSANTS, SOLVENT/SAMPLE RATIO)

- An important parameter is the solvent-to-matrix ratio in static extraction mode. This ratio should be as small as possible, on the one hand to avoid dilution of the extract, but at the same time large enough to provide the highest possible extraction yield

- In solid samples, the particle size affects mass transfer and should be optimized to maximize the contact surface. This facilitates better accessibility of the solvent to the analyte. The migration rate of the analyte through the pores of the matrix increases with decreasing particle size. However, the particle size must be large enough to avoid channeling effects (i.e., agglomeration of particles)

- The use of dispersants such as glass beads and diatomaceous earth is sometimes common, to promote uniform distribution for extraction yield. Moisture content can also affect extraction yield. The presence of water can compete with the extraction solvent and decrease the extraction ratio.

Method Validation Focused On Unique Matrix

An Automated Approach for Green Coffee and Tea Using Liquid Chromatography Coupled to Mass Spectrometry

Implementation of automated sample extraction using PLE

When dealing with complex matrix,
what aspects should be considered?

Complex matrix → **High content of natural compounds**

- Carotenoids
- Flavonoids
- Polyphenols
- Tocopherols
- Natural pigments
- Essential oils
- Lipids

High content of natural compounds → **Extraction Problems**

- Coextraction of matrix compounds
- Need hydration step

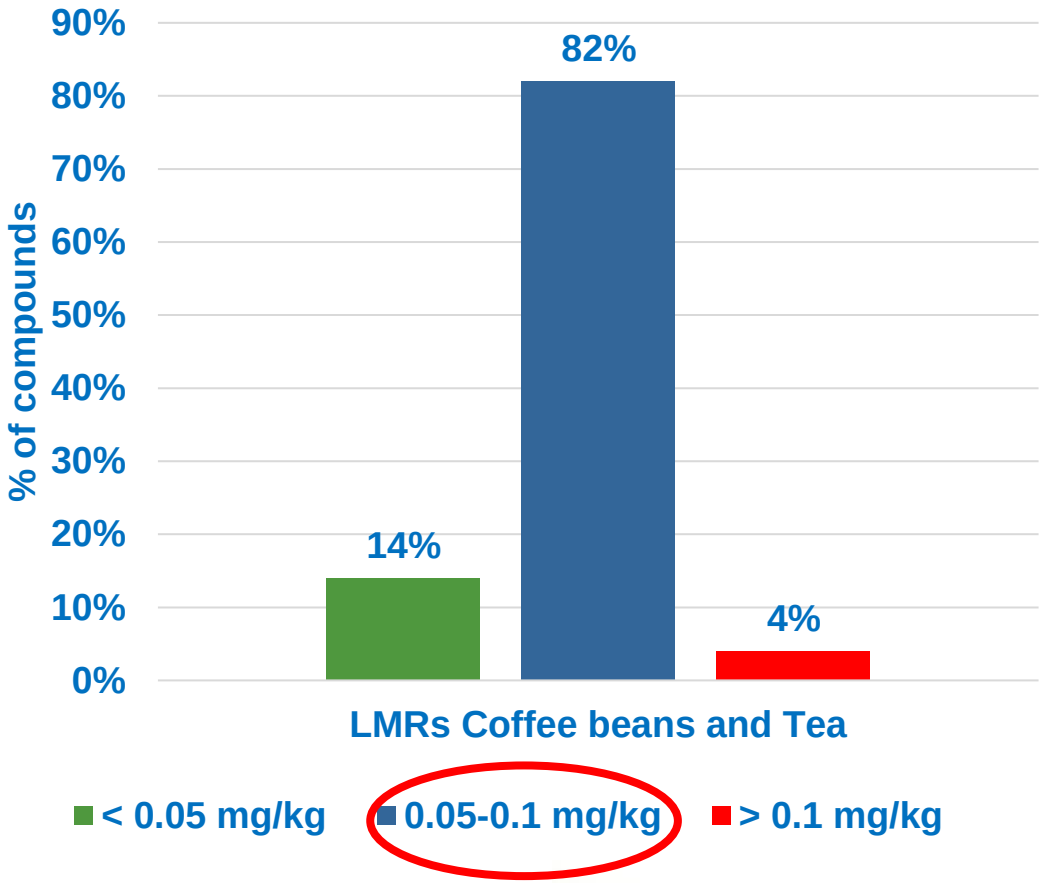
High content of natural compounds → **Instrumental Problems**

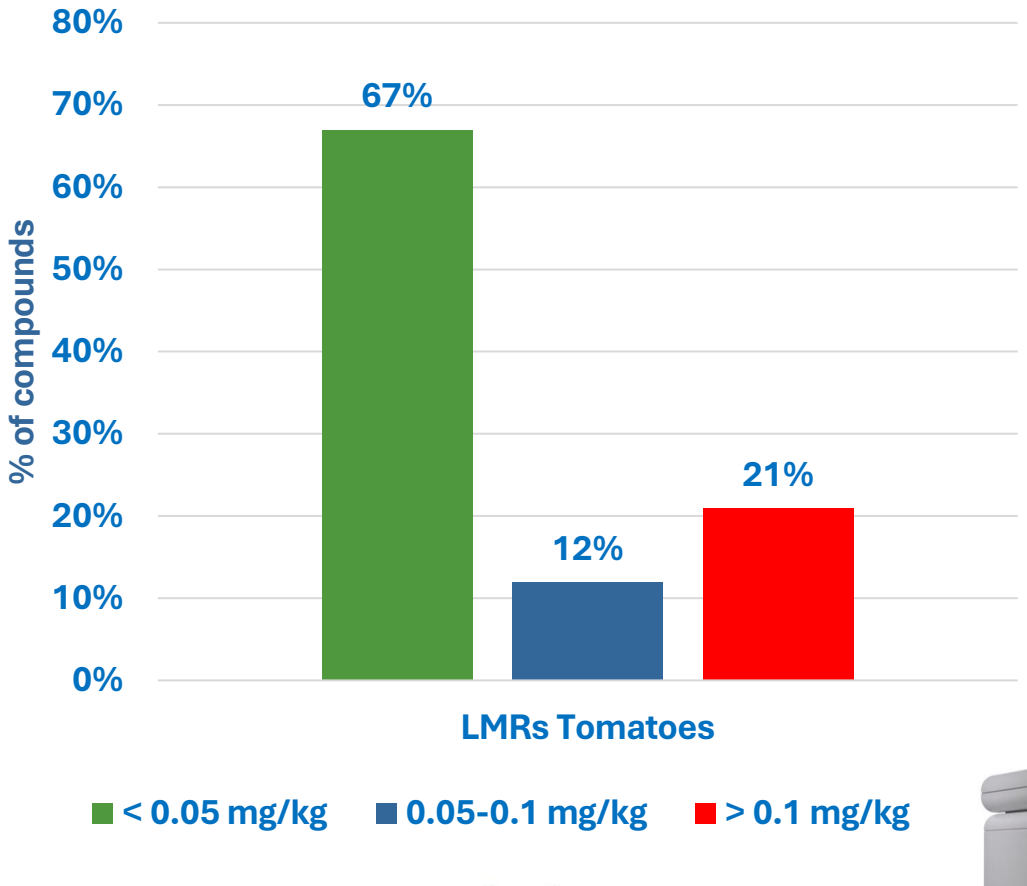
- Supression
- Interferences
- false positives

Implementation of automated sample extraction using PLE

European Commission

Legislation in the European union





Implementation of automated sample extraction using PLE

EXTREVA ASE (ThermoFisher Scientific)

Extraction method parameters:

- Oven temperature:45ºC
- Purge Time:30 Sec
- Gas Flowrate: 10 mL/min
- Cell type: SST 22 mL
- Cell fill volumen: 50%
- Flowrate: 0.5 mL/min
- Extraction time: 8 min
- Estimated volumen: 20 mL

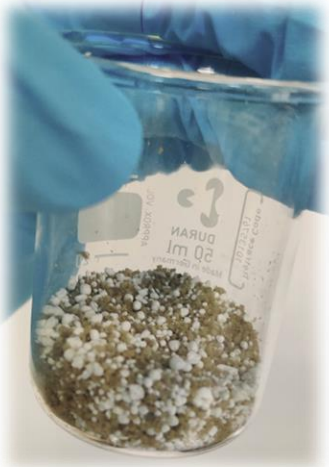
Pressure: 203 psi (13.8 atm)
Solvent: AcN/MeOH 1:1
Rinse: Pre-Run 5mL
Collection Bottle: 60 mL
Filters: ASE extraction filters Cellulose
DE: Diatomaceous Earth (ASE)

Volume collected: 10 mL

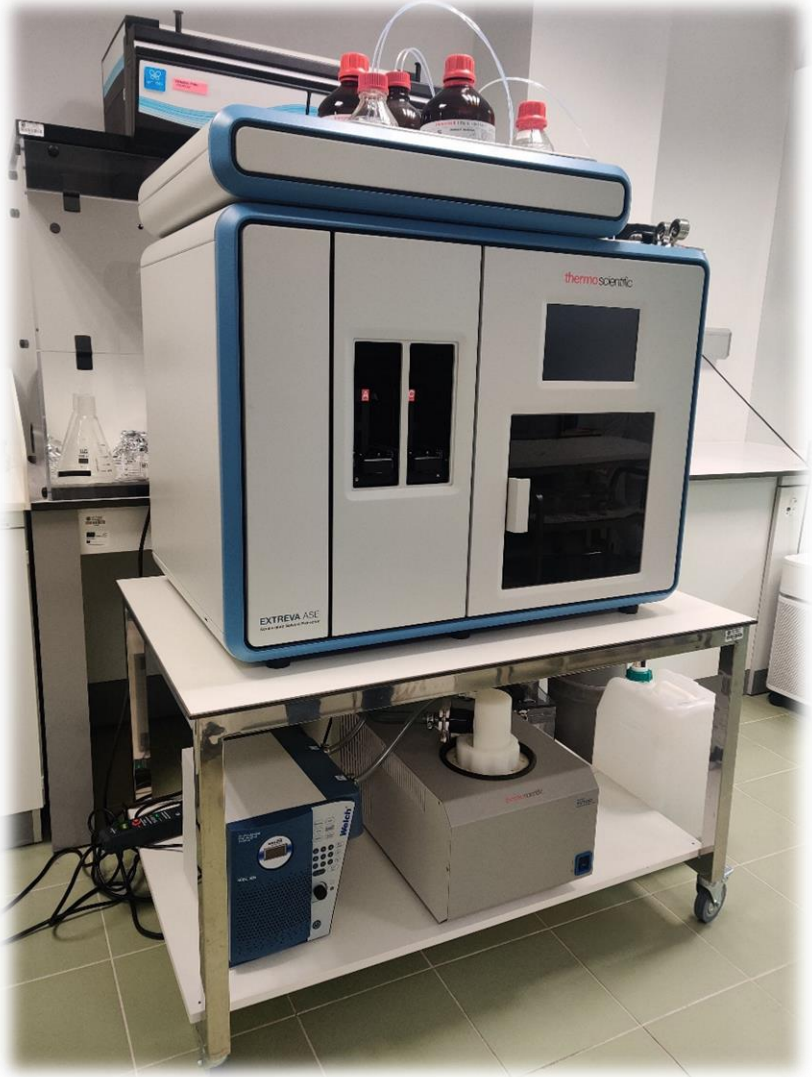
3g of sample hydrated with 3mL of water

↓ **5 min (hydratation)**

Mix 3g of hydrated sample with 3g of DE



- **filters**
- **Mix sample and DE**
- **225 mg $MgSO_4$**
- **filters**



Implementation of automated sample extraction using PLE

3g of sample hydrated with 3mL of water

Internal standard

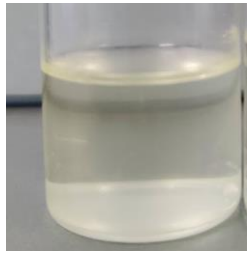
5 min (hydratation)

Mix 3g of hydrated sample with 3g of DE

Cell Assembly

- filters
- Mix sample and DE
- 225 mg $MgSO_4$
- filters

ASE



Volume collected 10mL

Transfer to a 15 mL tube

In the case of Coffee, aply freezing out (20min)

Lipid precipitate

Centrifuge 1 min. 3500 r.p.m

Black Tea

Green Coffee Lipid precipitate

100 µL of extract

400 µL of water with Dimethoate-D6

LC-MS/MS Analysis (0.04 g sample/mL extract)

Implementation of automated sample extraction using PLE

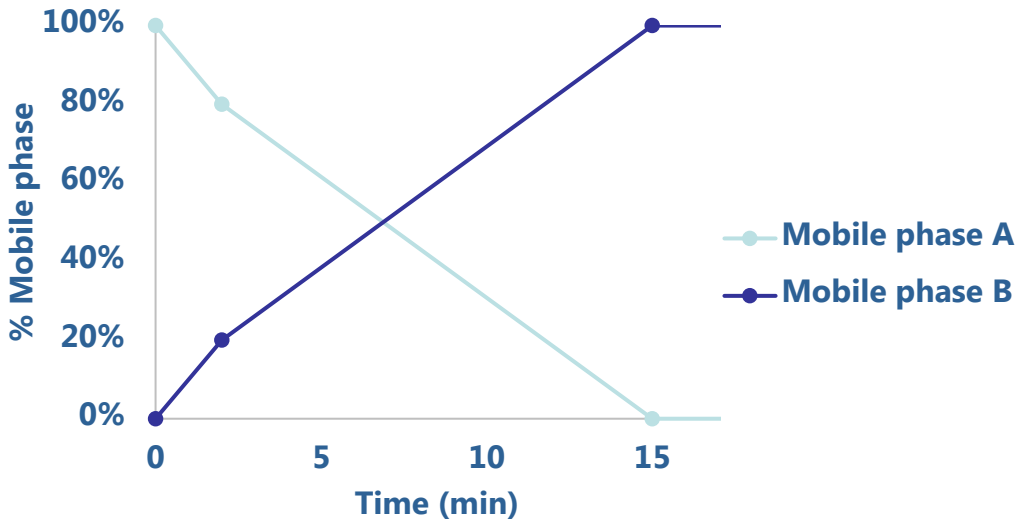
LC-QqQ-*MS/MS* Parameters:

Instrumentation and analytical conditions for the LC- MS/MS system

- Column: Zorbax Eclipse Plus C8 2.1x100 mm and a 1.8 µm particle size
- Mobile phase A: Water (0.1 % formic acid, 5 mM ammonium formate, 2 % MeOH)
- Mobile phase B: Methanol (0.1 % formic acid, 5 mM ammonium formate, 2 % water)
- Column temperature: 35 ºC
- Flow rate: 0.3 ml/min
- Injection volume: 5 µL
- Autosampler temperature: 12 ºC

Triple quadrupole system

- Ionisation mode: Positive mode and negative mode
- Capillary (positive and negative): 3000 V
- Nebulizer: 45 psi
- Nozzle: 400 V
- Drying gas flow: 13 L/min
- Drying gas temperature: 120ºC
- Sheath gas flow: 10 L/min
- Sheath gas temperature: 375ºC
- High Pressure RF (positive): 150 V
- High Pressure RF (negative): 110 V
- Low Pressure RF (positive): 60 V
- Low Pressure RF (negative): 60 V



Gradient of mobile phase

6490A triple quadrupole system (Agilent)

Implementation of automated sample extraction using PLE

The influence of calibration must be taken into account, in order to carry out a good strategy for quantifying our results

what type of calibration should I use?

Procedural Standard

Blank

Addition of analytes

PLE

- ✓ Reduces losses in term of recovery
- ✓ Reduces matrix effect

Matrix-matched calibration

Blank
PLE

Addition of analytes

- ✓ Reduces matrix effect

Used for method validation

Used to calculate matrix effects

Experiment for absolute recovery is necessary during initial validation

Implementation of automated sample extraction using PLE

LC-QqQ-*MS/MS Validation Coffee(Document SANTE)*

Linearity: 0.005 mg/Kg to 0.1 mg/Kg R^2 was higher than(0.99)
Repeatability: Evaluate 5 recovery replicates at 0.01, 0.02 and 0.05 mg/Kg (RSD ≤ 20 %)
Recovery: At 3 levels one at 0.01 mg/Kg, 0.02mg/Kg and other 0.05 mg/Kg (70-120%)
Reproducibility: RSDwRi ≤ 20 %
Uncertainty: 50%

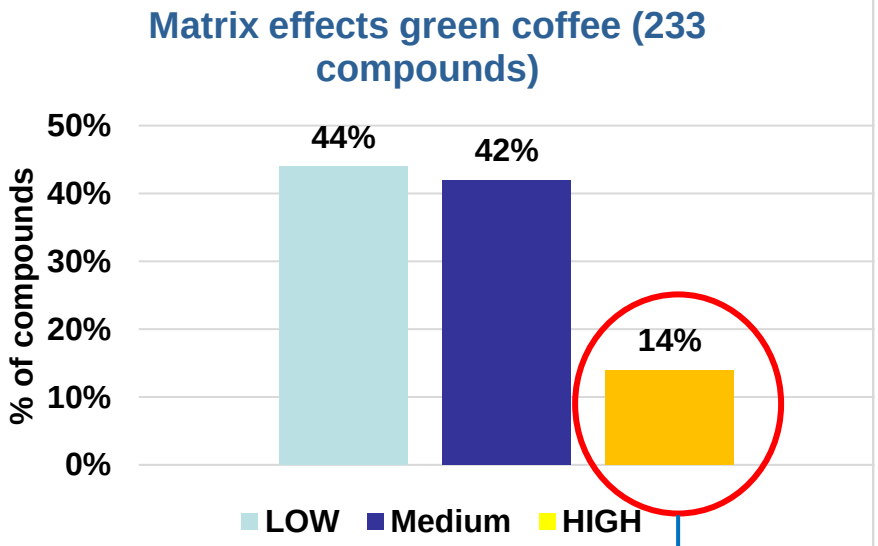
233 Compound Validated

- 89% of compound LOQ 0.01 mg/Kg
- 11% of compound LOQ 0.02 mg/Kg

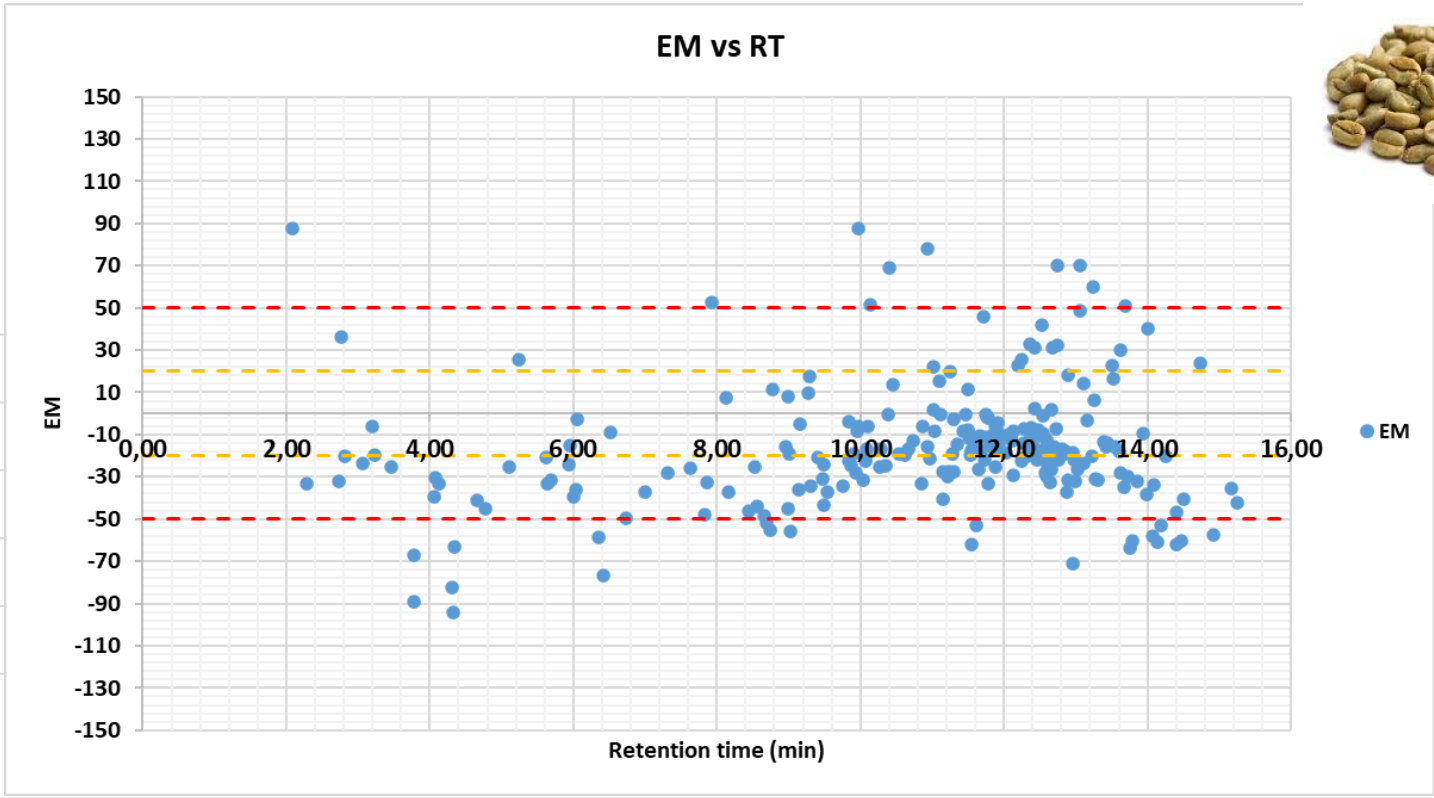
Acephate	Carbofuran	Desethylterbuthylazine	Etofenprox	Fenthion-sulfoxide	Haloxyfop-methyl	Oxadiargyl	Propargite	Spirodiclofen
Acetamiprid	Chlorantraniliprole	Diazinon	Etoxazole	Fenuron	Hexaconazole	Oxadixyl	Propazine	Spiromesifen
Alachlor	Chlorbromuron	Dichlorvos	Fenamidone	Fipronil	Hexaflumuron	Oxamyl	Propiconazole	Spirotetramat
Ametoctradin	Chlorfenvinphos	Dicrotophos	Fenamiphos	Flazasulfuron	Hexythiazox	Oxasulfuron	Propoxur	Sulfoxaflor
Anilofos	Chloridazon	Diethofencarb	Fenamiphos-sulfone	Flonicamid	Imazalil	Oxathiapipronil	Propyzamide	Tebuconazole
Atrazine	Chlorotoluron	Difenoconazole	Fenamiphos-sulfoxide	Florpyrauxifen-benzyl	Imidacloprid	Oxfendazole	Proquinazid	Tebufenozide
Azinphos-ethyl	Chloroxuron	Difenoxuron	Fenarimol	Fluacrypyrim	Indoxacarb	Paclobutrazol	Prosulfocarb	Tebufenpyrad
Azinphos-methyl	Chlorpyrifos	Diflubenzuron	Fenazaquin	Fluazifop	Ioxynil	Penconazole	Pymetrozine	Teflubenzuron
Azoxystrobin	Chromafenozide	Dimethoate	Fenbendazole	Flubendiamide	Iprovalicarb	Pencycuron	Pyraclostrobin	Terbutryn
Benalaxyl	Clofentezine	Dimethomorph	Fenbuconazole	Flufenacet	Isofenfos-methyl	Pendimethalin	Pyridaben	Tetraconazole
Bendiocarb	Clomazone	Dimethylvinphos	Fenhexamid	Flufenoxuron	Isoprocarb	Penflufen	Pyridalyl	Tetramethrin
Benzovindiflupyr	Coumaphos	Diniconazole	Fenobucarb	Fluometuron	Isoprothiolane	Phenthoate	Pyridaphenthion	Thiabendazole
Bifenazate	Cyantraniliprole	Dinotefuran	Fenoxycarb	Fluopyram	Isoproturon	Phosalone	Pyridate	Thiacloprid
Bifenthrin	Cyflufenamid	Diuron	Fenpicoxamid	Flupyradifuron	Isoxaflutole	Phosmet	Pyrimethanil	Thiamethoxam
Bitertanol	Cymoxanil	Dodine	Fenpropathrin	Fluquinconazole	Kresoxim-methyl	Phoxim	Pyriofenone	Thiobencarb
Boscalid	Cyproconazole	Edifenphos	Fenpropidin	Flusilazole	Lenacil	Pirimicarb	Pyriproxyfen	Tolclofos-methyl
Bromuconazole	Cyprodinil	EPN	Fenpropimorph	Flutriafol	Lufenuron	Pirimiphos-methyl	Quinalphos	Tolfenpyrad
Bupirimate	Cyromazine	Epoxiconazole	Fenpyrazamine	Fluxapyroxad	Malathion	Prochloraz	Quinoclamine	Triadimefon
Buprofezin	Deltamethrin	Ethion	Fenpyroximate	Forchlorfenuron	Mandipropamid	Profenofos	Quinoxyfen	Triallate
Butoxycarboxim	Demeton-S-methyl	Ethiprole	Fensulfothion	Formetanate Hydrochloride	Mebendazole	Promecarb	Quizalofop	Triazophos
Carbaryl	Demeton-S-methylsulfone	Ethirimol	Fenthion	Fosthiazate	Mefentrifluconazole	Propamocarb	Quizalofop-ethyl	Trichlorfon
Carbendazim	Demeton-S-methylsulfoxide	Ethoprophos	Fenthion-sulfone	Haloxyfop	Metaflumizone	Propaquizafop	Simazine	Triclorcarban
Metalaxyl	Metamitron	Metconazole	Methamidophos	Methidathion	Methiocarb	Methiocarb-sulfone	Spinosyn A	Tricyclazole
Methiocarb-sulfoxide	Methomyl	Methoxyfenozide	Metobromuron	Metolachlor	Metrafenone	Monocrotophos	Spinosyn D	Trifloxystrobin
Monolinuron	Monuron	Myclobutanil	Neburon	Nitenpyram	Novaluron	Omethoate	Orthosulfamuron	Triflumizole
Triflumuron	Trinexapac-ethyl	Trinexapac-methyl	Triticonazole	Tritosulfuron	Valifenalate	XMC	Zoxamide	

Implementation of automated sample extraction using PLE

Matrix Effects



233 compound evaluated

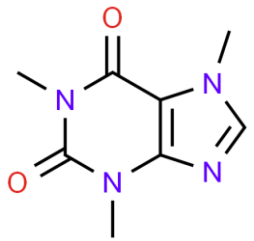


Tritosulfuron	Flonicamid	Oxamyl	Orthosulfamuron	Cyromazine	Triclorcarban
Flazasulfuron	Nitenpyram	Chlorpyrifos	Demeton-S-methylsulfone	Fenazaquin	Methiocarb-sulfone
Propargite	Etofenprox	Desethylterbuthylazine	Demeton-S-methyl	Spiromesifen	Thiacloprid
Thiamethoxam	Fluazifop	Cymoxanil	EPN	Oxadiargyl	
Bifenazate	Proquinazid	Deltamethrin	Ethion	Novaluron	
Azinphos-ethyl	Oxfendazole	Carbofuran	Isoxaflutole	Lufenuron	

Implementation of automated sample extraction using PLE

Matrix Effects

- The elution of caffeine coincides with the highest suppression values and the suppression values decrease as caffeine elutes



Caffeine
ESI (+) (m/z 195)

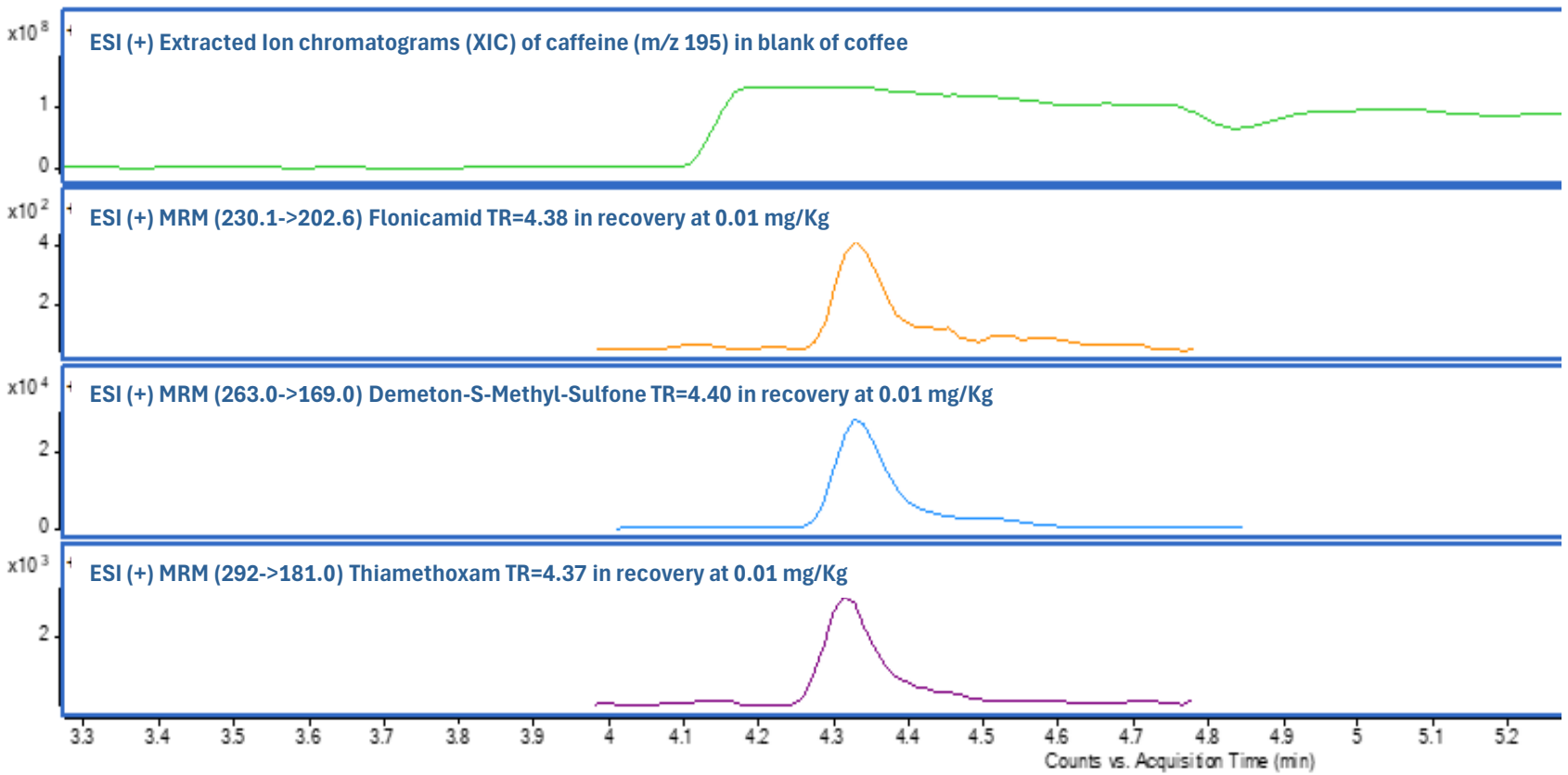
Implementation of automated sample extraction using PLE

Matrix Effects

- The elution of caffeine coincides with the highest suppression values and the suppression values decrease as caffeine elutes

Demeton-S-Methylsulfone (EM=-63)
Thiamethoxam (EM= -82)
Flonicamid (EM= -94)

High values of suppression



Implementation of automated sample extraction using PLE

LC-QqQ-*MS/MS Validation Tea (Document SANTE)*

Linearity: 0.005 mg/Kg to 0.1 mg/Kg R^2(0.999)
Repeatability: Evaluate 5 recovery replicates at 0.01, 0.02 and 0.05 mg/Kg (RSD ≤ 20 %)
Recovery: At 3 levels one at 0.01 mg/Kg, 0.02mg/Kg and other 0.05 mg/Kg (70-120%)
Reproducibility: RSDwRi ≤ 20 %
Uncertainty: 50%

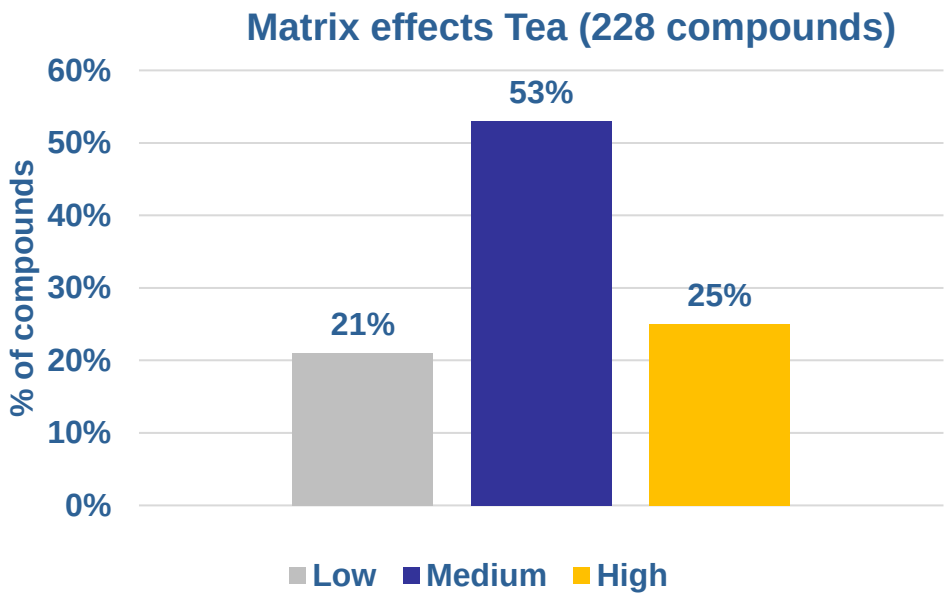
228 Compound Validated

- **90% of compound LOQ 0.01 mg/Kg**
- **10% of compound LOQ 0.02 mg/Kg**

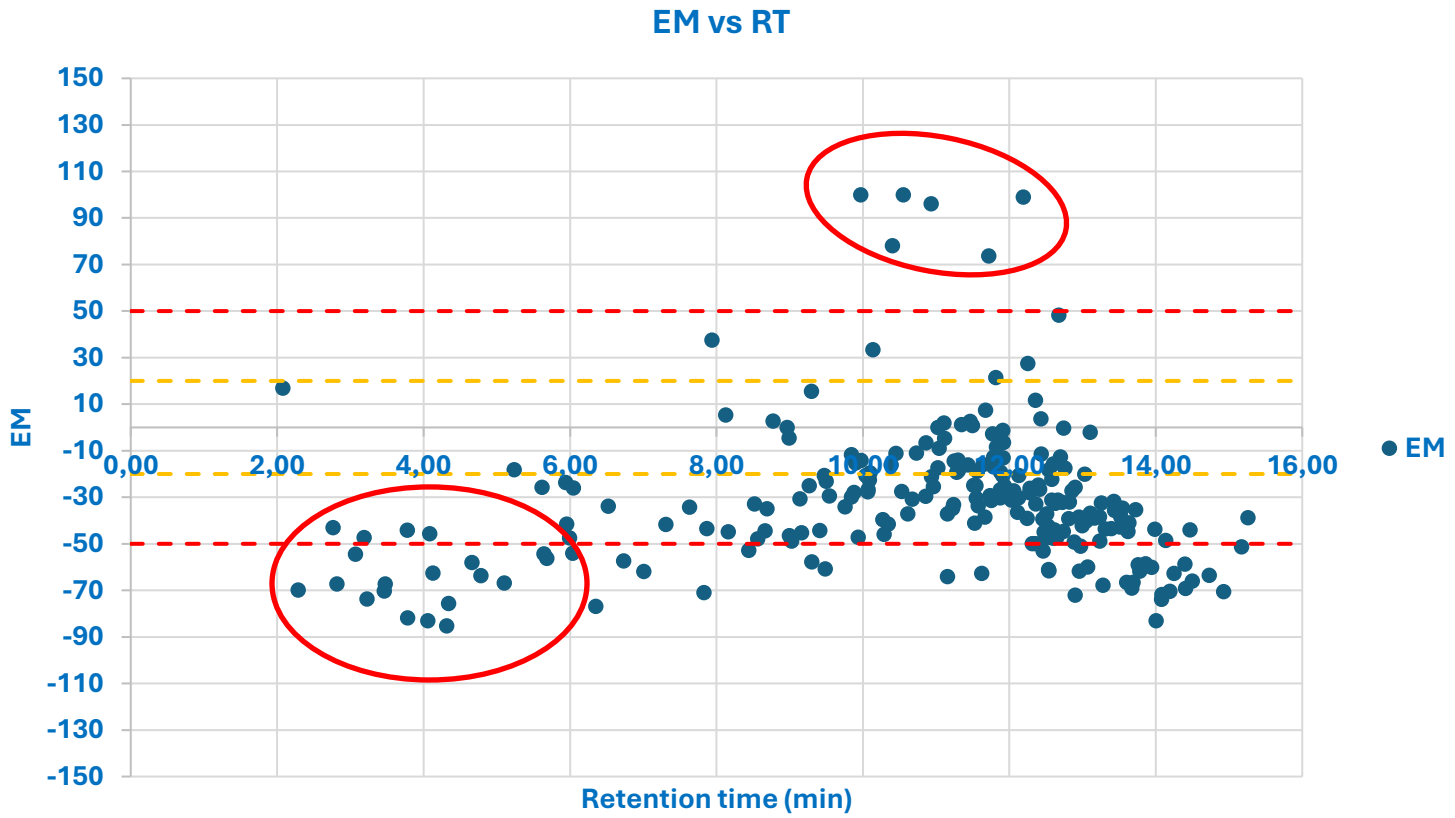
Acetamiprid	Benzovindiflupyr	Carbofuran	Cyantraniliprole	Diuron	Famoxadone	Fenoxycarb	Fenuron	Flubendiamide	Flupyradifuron
Alachlor	Bifenazate	Chlorbromuron	Cyflufenamid	Dodine	Fenamidone	Fenbendazole	Fenpyroximate	Dicrotophos	Fluquinconazole
Aldicarb-sulfone	Bitertanol	Chlorfenvinphos	Cyproconazole	Edifenphos	Fenamiphos	Fenpicoxamid	Deltamethrin	Flufenacet	Flusilazole
Anilofos	Boscalid	Chloridazon	Cyprodinil	Diniconazole	Ethoprophos	Fenpropathrin	Fipronil	Diethofencarb	Flutriafol
Atrazine	Bromuconazole	Chlorotoluron	Cyromazine	EPN	Fenamiphos-sulfone	Fenpropidin	Demeton-S-methylsulfone	Flufenoxuron	Forchlorfenuron
Azinphos-ethyl	Bupirimate	Chloroxuron	Coumaphos	Epoxiconazole	Fenamiphos-sulfoxide	Fenpropimorph	Flazasulfuron	Fluometuron	Formetanate Hydrochloride
Azinphos-methyl	Buprofezin	Chlorantraniliprole	Diflubenzuron	Ethion	Fenarimol	Fenpyrazamine	Demeton-S-methylsulfoxide	Difenoconazole	Fosthiazate
Ametoctradin	Bifenthrin	Chlorpyrifos	Dimethoate	Ethiprole	Fenazaquin	Fensulfothion	Florpyrauxifen-benzyl	Diazinon	Haloxyfop
Azoxystrobin	Butoxycarboxim	Chromafenozide	Dimethomorph	Ethirimol	Fenbuconazole	Fenthion	Desethylterbuthylazine	Fluopyram	Haloxyfop-methyl
Benalaxyl	Carbaryl	Clofentezine	Dimethylvinphos	Etofenprox	Fenhexamid	Fenthion-sulfone	Fluacrypyrim	Fluazifop	Fluxapyroxad
Bendiocarb	Carbendazim	Clomazone	Dinotefuran	Etoxazole	Fenobucarb	Fenthion-sulfoxide	Dichlorvos	Difenoxuron	Hexaconazole
Oxathiapipronil	Oxfendazole	Paclobutrazol	Penconazole	Pencycuron	Oxasulfuron	Pendimethalin	Penflufen	Phenthoate	Phosalone
Prochloraz	Profenofos	Phosmet	Promecarb	Propamocarb	Propaquizafop	Propargite	Propiconazole	Propoxur	Propyzamide
Pymetrozine	Pyraclostrobin	Pyridaben	Pyridalyl	Pyridate	Pyrimethanil	Pyriofenone	Pyriproxyfen	Pyridaphenthion	Quinalphos
Omethoate	Spiromesifen	Rotenone	Spirotetramat	Sulfoxaflor	Tebuconazole	Tebufenozide	Teflubenzuron	Terbutryn	Tetraconazole
Thiamethoxam	Thiobencarb	Tolclofos-methyl	Triadimefon	Triallate	Triazophos	Trichlorfon	Tolfenpyrad	Triclorcarban	Tricyclazole
Hexaflumuron	Hexythiazox	Imazalil	Indoxacarb	Ioxynil	Iprovalicarb	Isofenfos-methyl	Imidacloprid	Isoprocarb	Isoprothiolane
Isoxaflutole	Phoxim	Proquinazid	Quinoclamine	Tetramethrin	Trifloxystrobin	Kresoxim-methyl	Lenacil	Malathion	Mandipropamid
Mebendazole	Mefentrifluconazole	Metaflumizone	Lufenuron	Metalaxyl	Metamitron	Metconazole	Pirimicarb	Propazine	Metobromuron
Thiabendazole	Triflumizole	Methamidophos	Methiocarb	Methiocarb-sulfone	Methiocarb-sulfoxide	Methomyl	Methidathion	Methoxyfenozide	Quinoxyfen
Orthosulfamuron	Oxadiargyl	Oxadixyl	Oxamyl	Pirimiphos-methyl	Prosulfocarb	Metolachlor	Tebufenpyrad	Triflumuron	Spinosyn D
Metrafenone	Quizalofop	Monocrotophos	Quizalofop-ethyl	Monuron	Simazine	Spinosyn A	Neburon	Nitenpyram	
Novaluron	Spirodiclofen	Monolinuron	Thiacloprid	Tritosulfuron	Valifenalate	XMC	Zoxamide	Trinexapac-ethyl	

Implementation of automated sample extraction using PLE

Matrix Effects

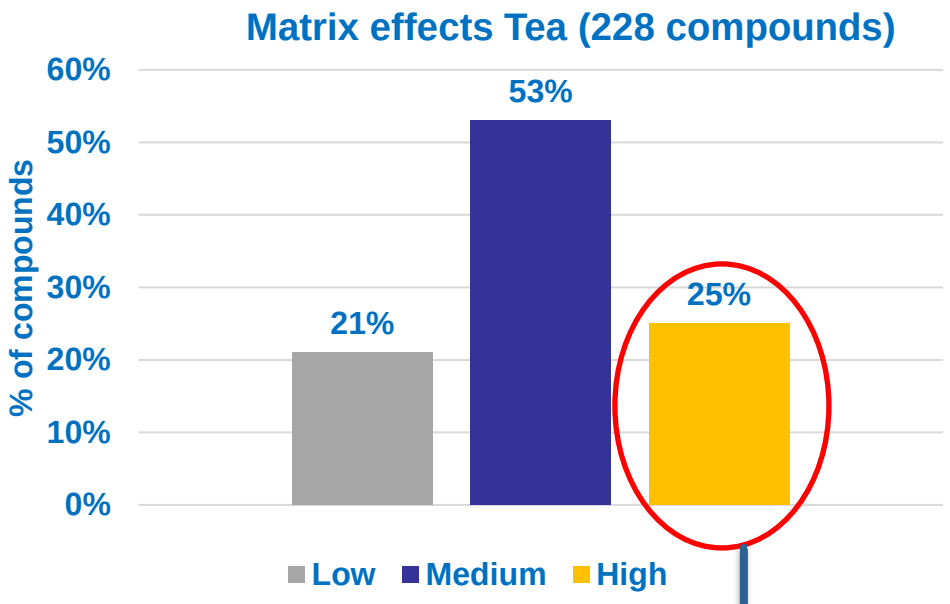


228 compound evaluated



Implementation of automated sample extraction using PLE

Matrix Effects

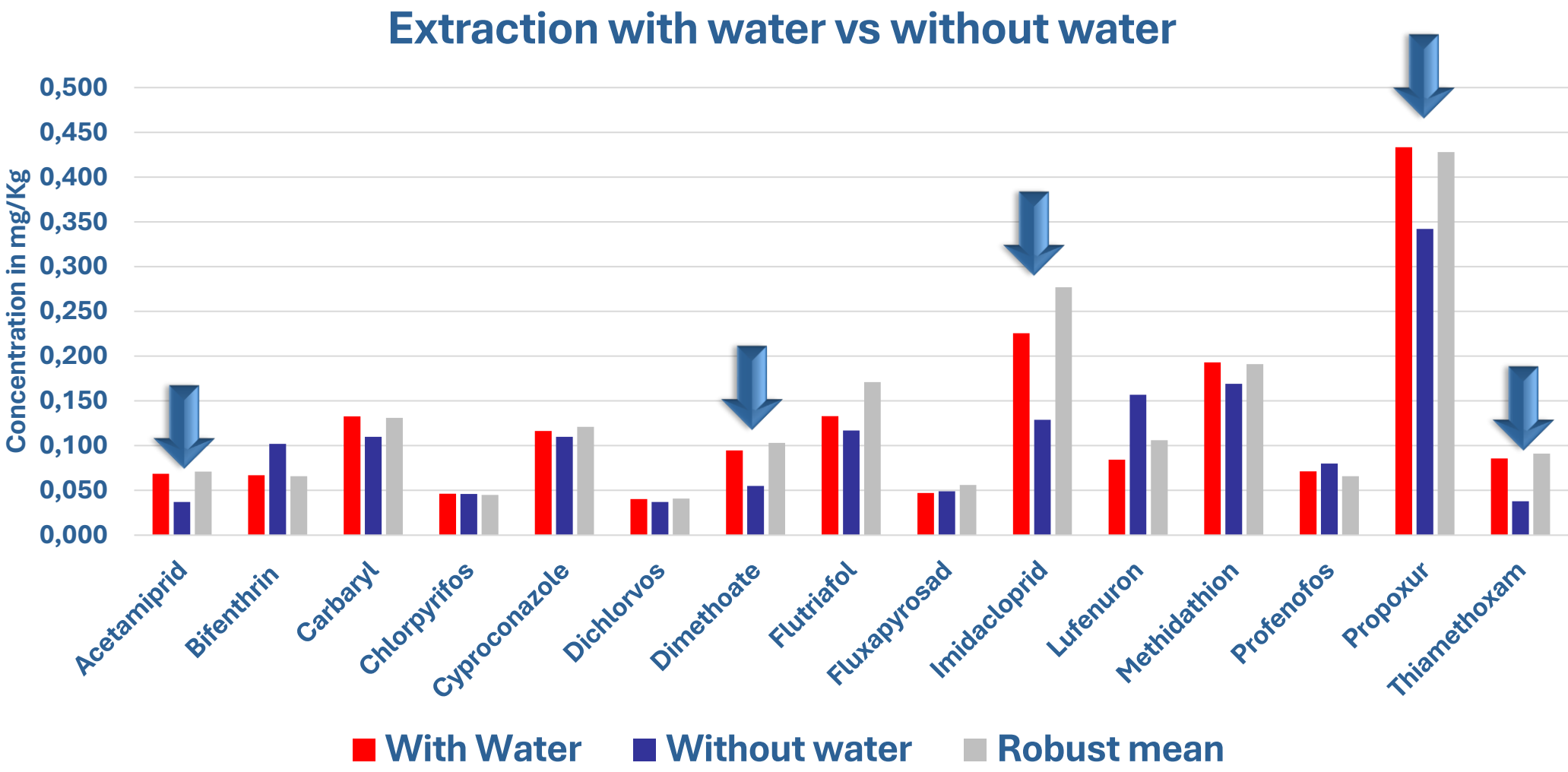


228 compound evaluated

Orthosulfamuron	Tritosulfuron	Haloxyfop
Spinosyn D	Etoxazole	Quinoclamine
Pyriproxyfen	Pyridaben	Fenbendazole
Hexythiazox	Hexaflumuron	Chlorpyrifos
Flufenoxuron	Oxamyl	Flazasulfuron
Methamidophos	Fenazaquin	Quinoxyfen
Fenpropathrin	Carbendazim	Tricyclazole
XMC	Thiacloprid	Methiocarb-sulfoxide
Spirotetramat	Dicrotophos	Dodine
Dinotefuran	Lufenuron	Chloridazon
Fluazifop	Thiamethoxam	Methomyl
Etofenprox	Spiromesifen	Butoxycarboxim
Thiabendazole	Pyridate	Azinphos-ethyl
Spirodiclofen	Pendimethalin	Monocrotophos
Methiocarb-sulfone	Demeton-S-methylsulfone	Propargite
Triflumizole	Formetanate Hydrochloride	Aldicarb-sulfone
EPN	Ethion	Spinosyn A
Omethoate	Fenuron	Dimethoate
Clofentezine	Bifenthrin	Ametoctradin
Simazine		

Implementation of automated sample extraction using PLE

LC-QqQ-*MS/MS Analysis of EUPT-FV-SC07*

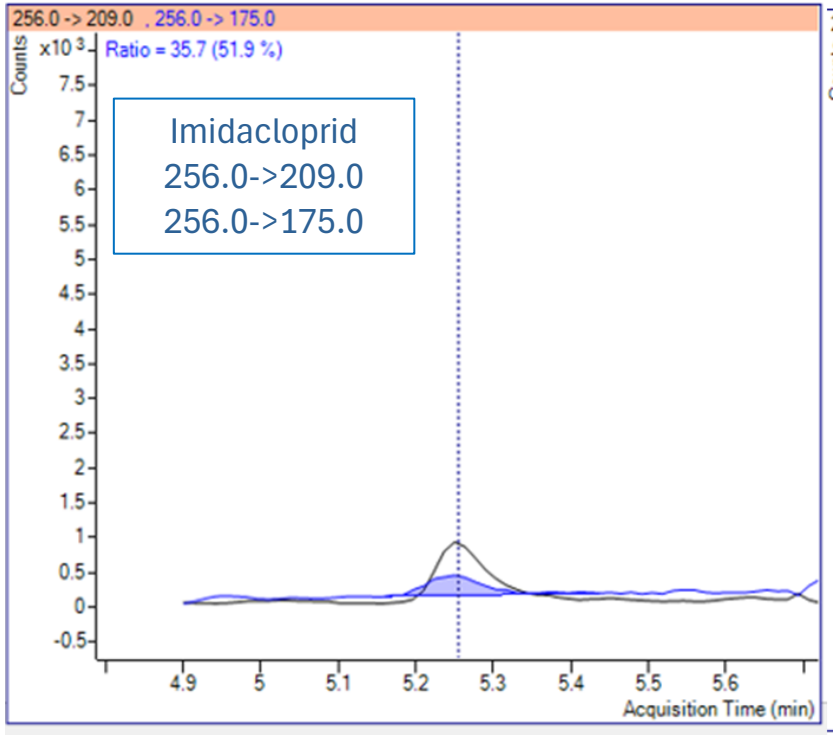


Implementation of automated sample extraction using PLE

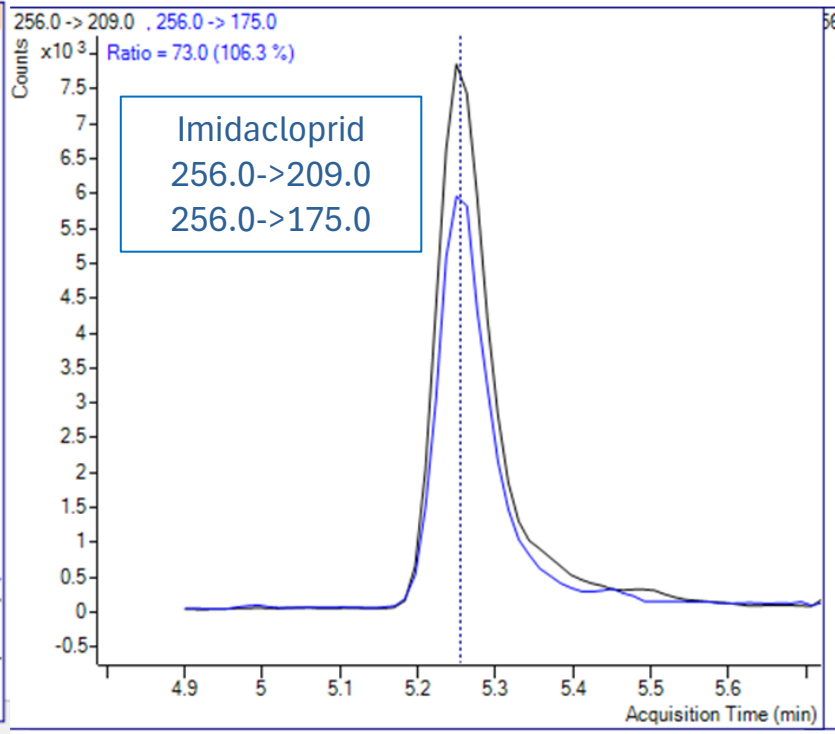
LC-QqQ-*MS/MS Analysis of real samples*

- A total of 20 samples of green coffee from Indonesia of different varieties have been analysed
- None of them showed results for pesticides residues >LOQ
- Pesticide residues were detected in 4% of the samples for < LOQ

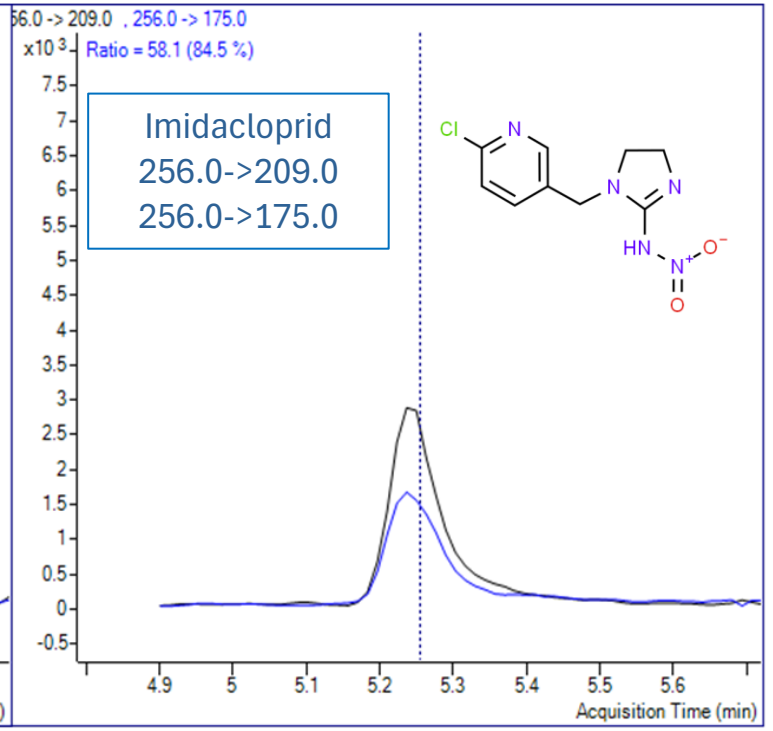
Carbofuran	**Isoprocarb**
Chlorpyrifos	**Imidacloprid**
Fenobucarb	**Propamocarb**



Blank Green Coffee



Standard at 0.01 in coffee mg/Kg



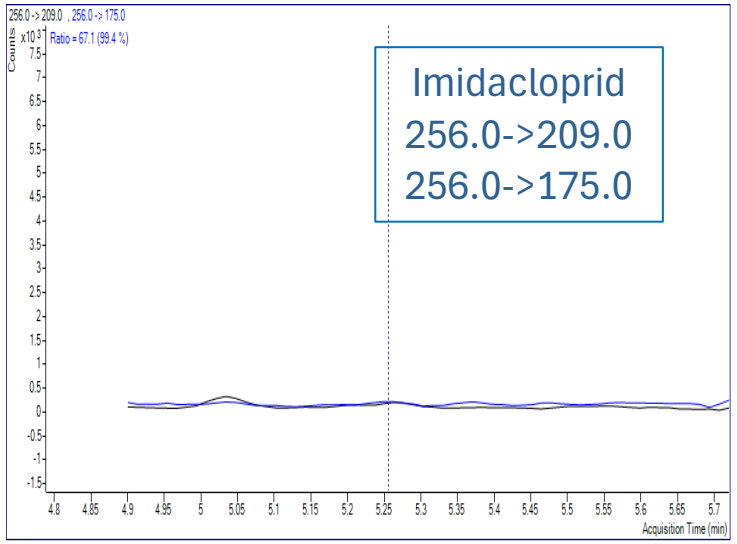
Sample 0.005 mg/Kg < LOQ

Implementation of automated sample extraction using PLE

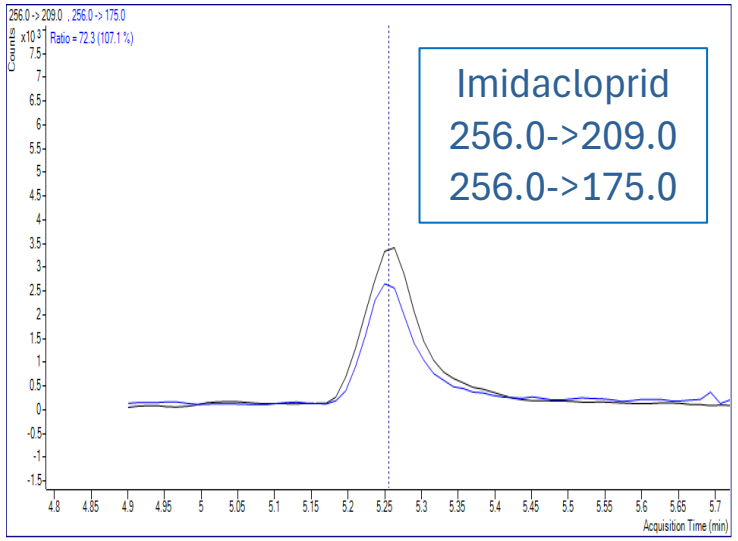
LC-QqQ-*MS/MS Analysis of real samples*

- A total of 20 samples of black tea from Indonesia have been analysed
- 70% of samples analysed have pesticide residues >LOQ

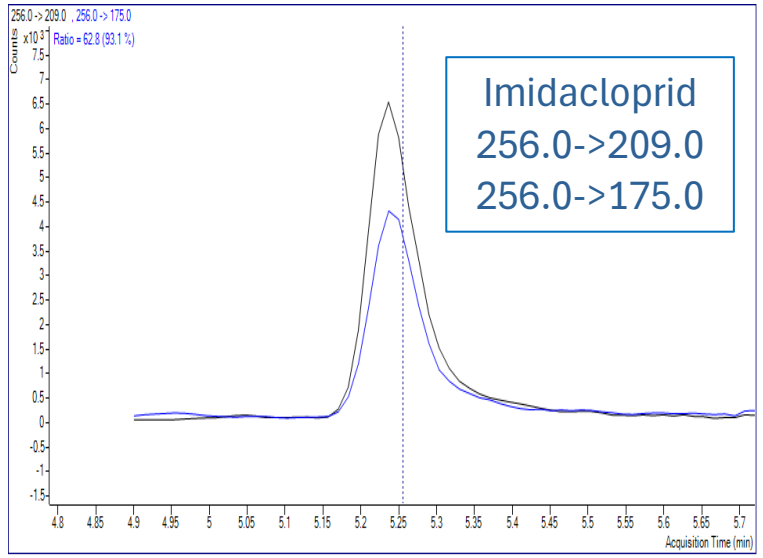
Propoxur	**Isoprocarb**
Pyridaben	**Imidacloprid**
Fenobucarb	**Propamocarb**



Blank tea



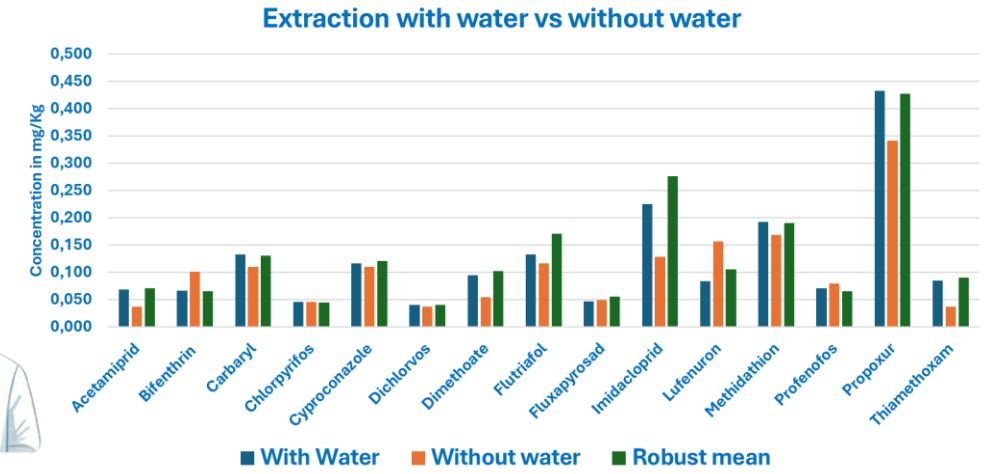
Standard at 0.01 mg/Kg in tea

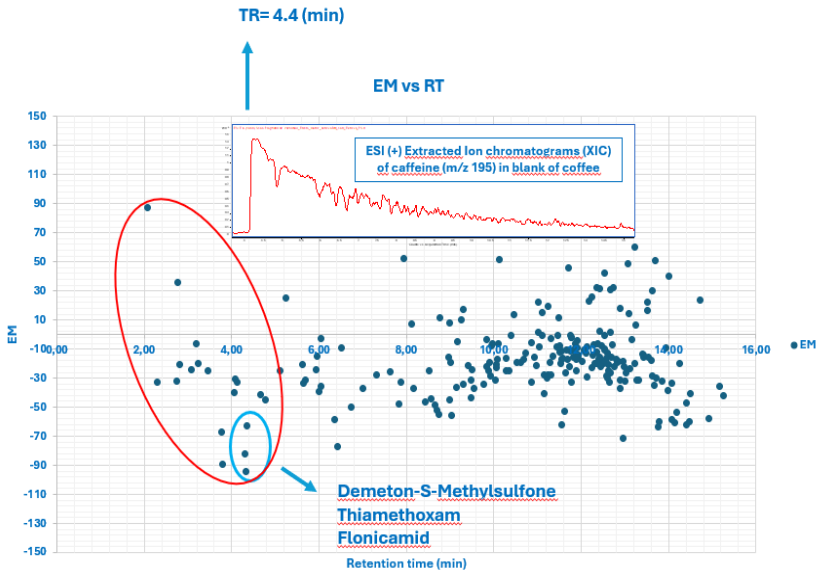


Sample 0.017 mg/Kg < LOQ

Implementation of automated sample extraction using PLE

- PLE is a good alternative to the QuEChERS methodology for the analysis of complex matrices
- The addition of water is necessary to extract the more polar pesticides
- In the case of green coffee as in tea, caffeine causes suppression during elution of compounds with common retention times
- Finally, it is necessary to consider the processing chain that these matrices undergo and how these affect the amount of pesticide residues detected in the matrices

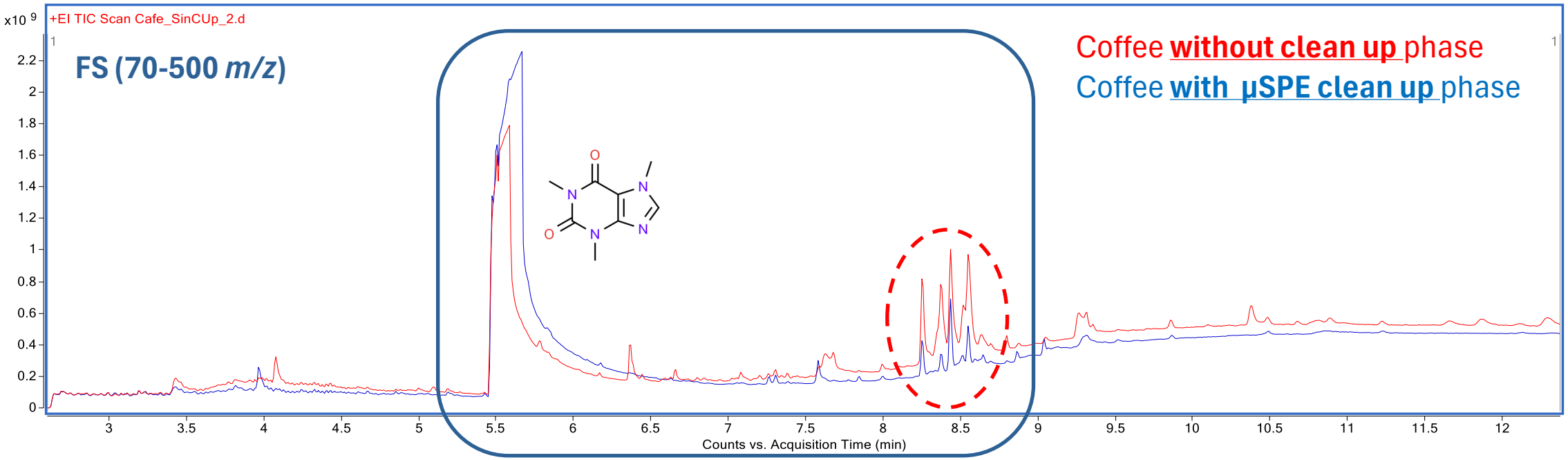




Implementation of automated sample extraction using PLE

Getting started in GC analysis:

- **When no PSA clean-up step is used, GC analysis becomes more complicated, especially in complex matrices**

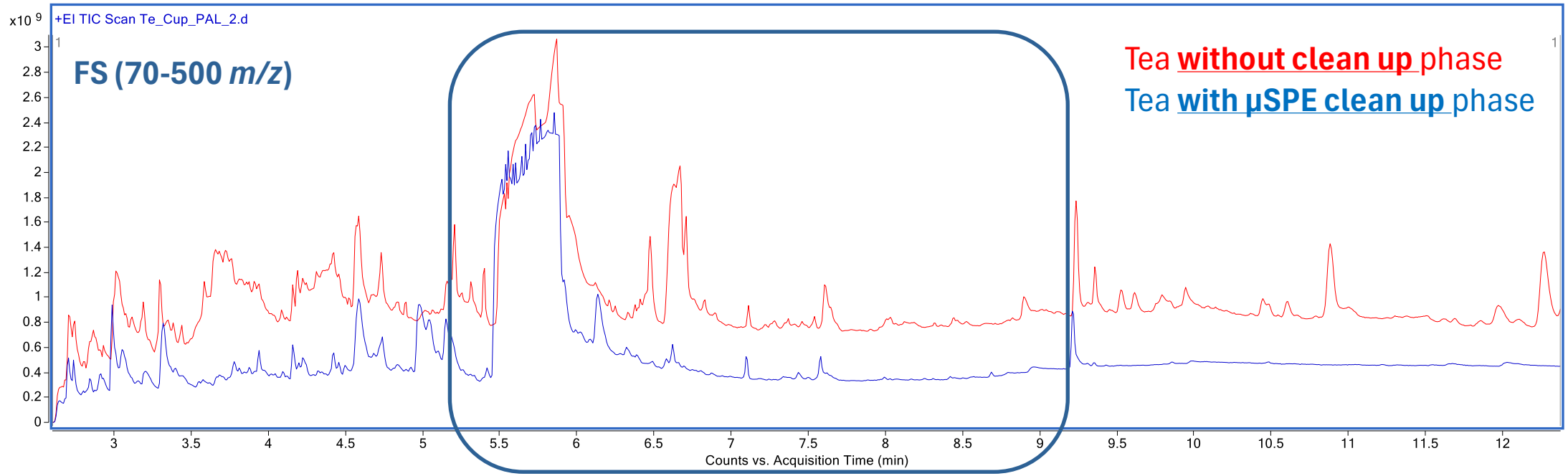


Pesticides elution zone

Implementation of automated sample extraction using PLE

Getting started in GC analysis:

- When no PSA clean-up step is used, GC analysis becomes more complicated, especially in complex matrices



Pesticides elution zone

In the case of tea, carrying out a µSPE stage can be crucial

Implementation of automated sample extraction using PLE

References:

- Alvarez-Rivera G, Bueno M, [...] Ibañez E. Elsevier, (2019), 375-398
- Subedi B, Aguilar L, [...] Usenko S. TrAC-Trends in Analytical Chemistry

Thank You
for Your Attention