

# **Solution of multi-residue analysis in food safety**

**Dr Yu Yanling**

# Presentation Overview

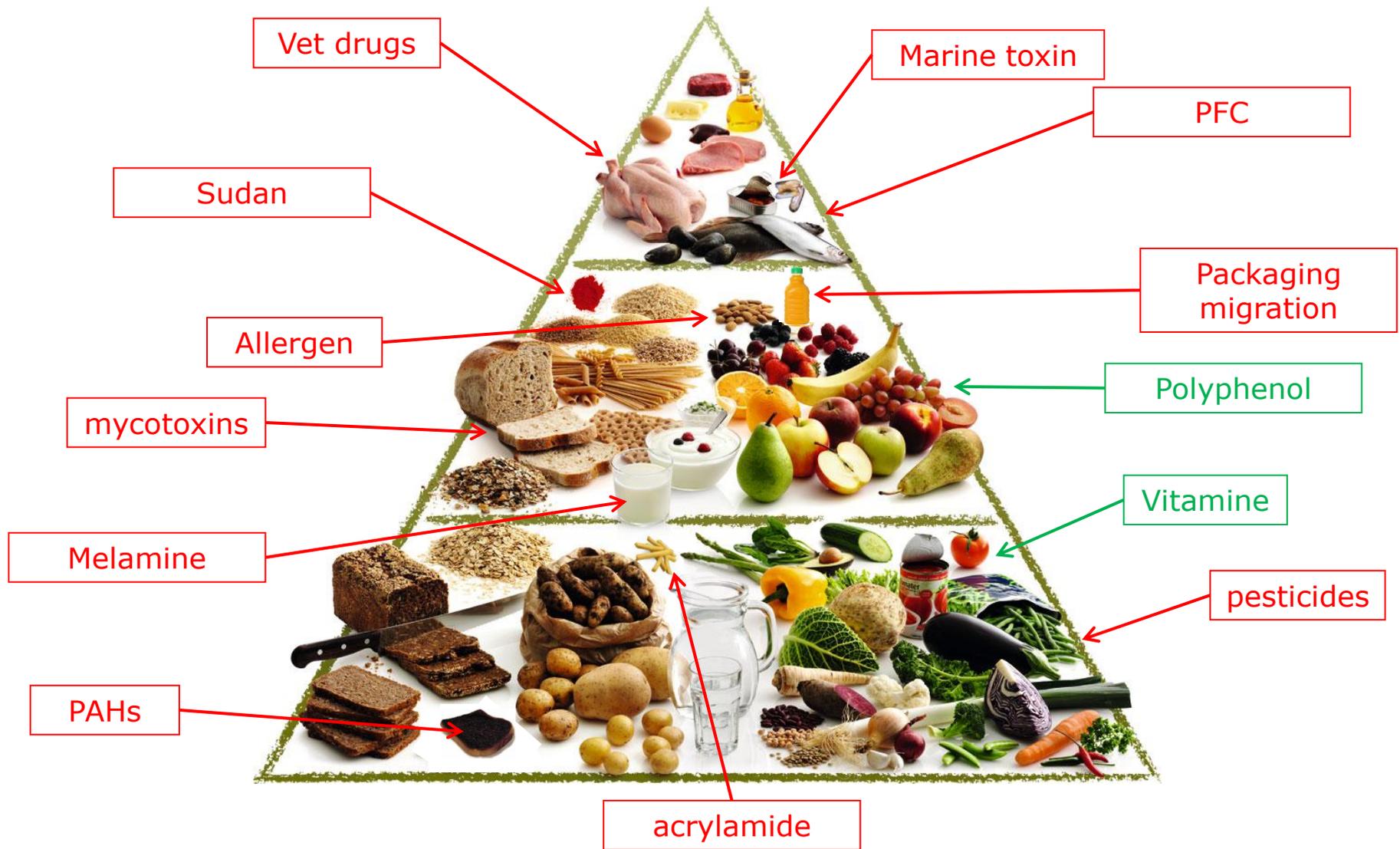


- Overview of Multi-residue analysis
  - Challenges in food safety analysis
  - customer's requirement
  - What should we focus on
- Experimental Information
  - Sample Preparation
  - Instruments conditions
- Results and Conclusions
  - Method performance
  - Advantage of the Multi-residue solutions



# The view of food safety

—Multitude of Compounds & Variety of Food Types



# What are the challenges?

## Variety of methods

mycotoxins

Pesticides

Veterinary drugs

Food additives

Contaminants

• • • • •

**More than 6,000  
compounds need to  
be detected**

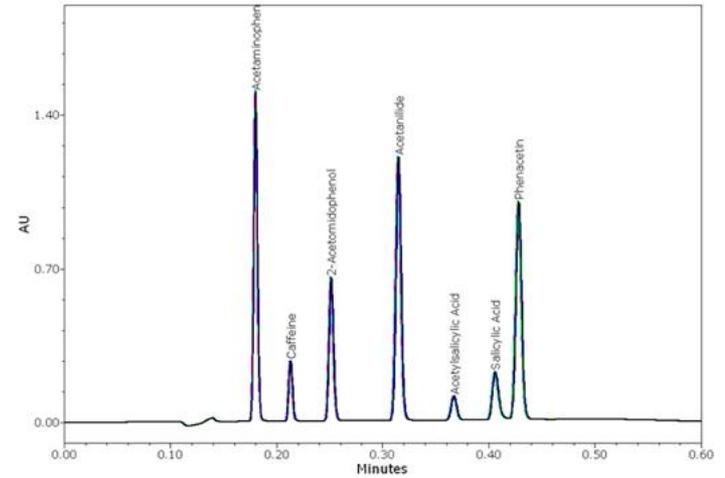
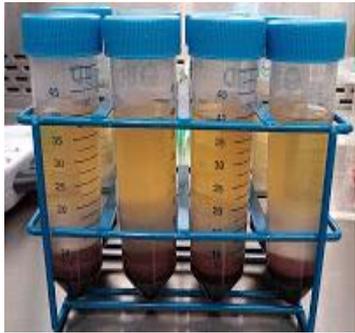
Part of the Vet Drugs Methods

Method	Analytes	Sample Matrix
GB/T22286	β-Adrenergic agonists	Muscle
GB/T21315	β-Lactam	Kidney and muscle
GB/T22338	Chloramphenicol	Muscle
GB/T20762	Macrolide	Liver, kidney, and muscle
GB/T21316	Sulfonamides	Liver and muscle
GB/T20366	Fluoroquinolone	Liver and muscle

# What 's the customer focus on?

How can I turn this?

Into this?



# Three major classes compounds in food safety

## Pesticides

### Organophosphates

Chlorpyrifos, Diazinon

### Carbamates

Aldicarb, Carbaryl

### Organochlorine

DDT, Endosulfan

### Pyrethroids (菊酯)

Cyfluthrin, Pyrethrin

### Sfonylureas ?

Rimsulfuron 玉密磺隆,

### Phenoxyacid Herbicides

2,4-D

### Triazines

Atrazine

### Ureas

Diuron

### Acetanilides

Metolachlor, alachlor

### Neonicotinoids

Imidacloprid

### Imidazolinones

Imazapyr

## Veterinary Drugs

### Tetracyclines

Oxytetracycline

### Fluoroquinolones

Enrofloxacin

### Sulfonamides

Sulfamerazine

### Macrolides

Erythromycin

### Beta-Lactams

Amoxicillin

### Amphenicols

Chloramphenicol

### Steroids

Dexamethasone

### Beta-Adrenergics

Albuterol

### Aminoglycosides

Streptomycin

## Mycotoxins

### Aflatoxins

Aflatoxin B

### Fumonisin

Fumonisin A

### Trichothecenes

HT-2 Toxin,  
Deoxynivalenol (DON)

### Ochratoxins

Ochratoxin A

### Estrogenic Metabolites

Zearalenone

### Phenolic

Citrinin

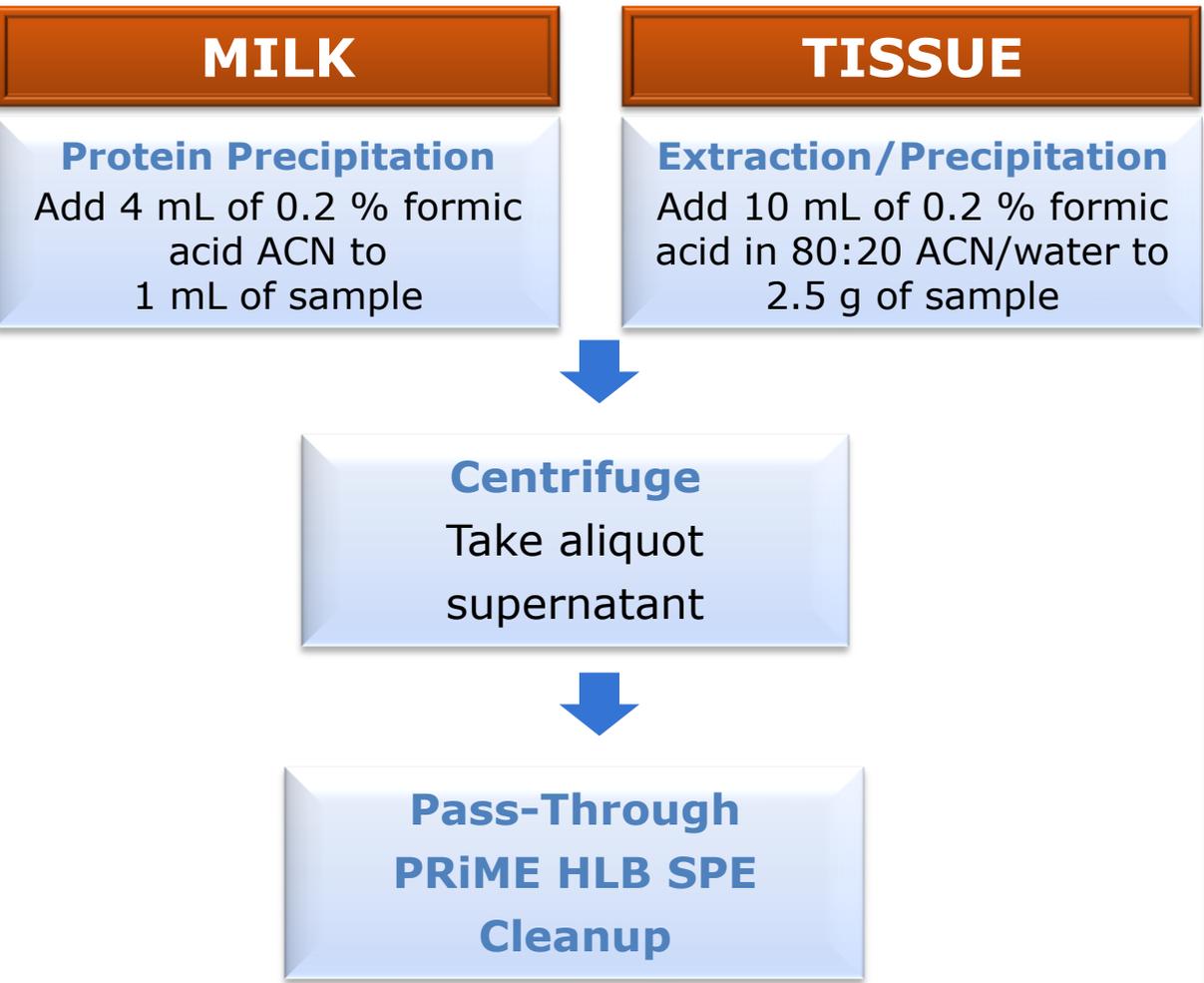
MassLynx - S160\_CEFAS - TQ51\_13DEC11\_DSP2\_windows.SPL

Queue Is Empty

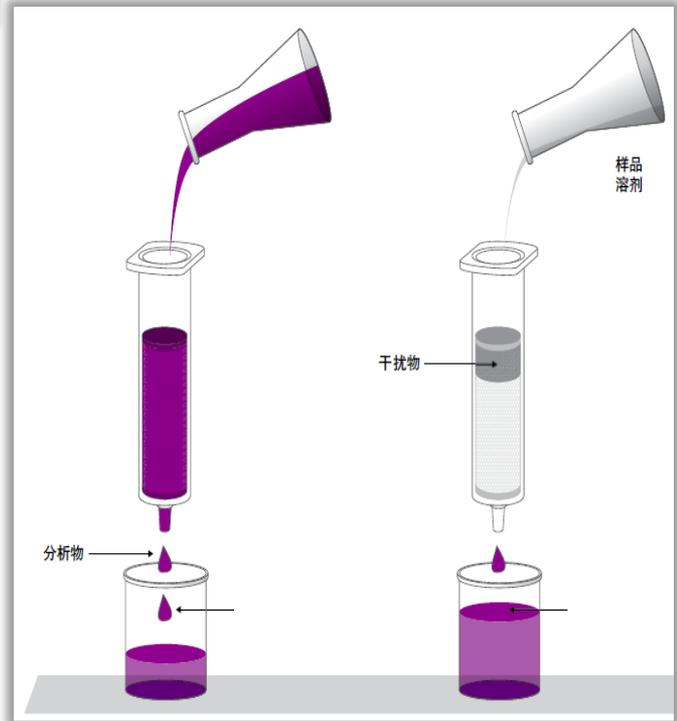
Sample ID	File Text	MS File	Inlet File	Bottle	Injct Volume	Sample Type	Conc A	Quan 1
1	TQ51_13DEC2011_DSP2_001	sopa1127-2_SJC_window	SOPA1127 UPLC-2	1.3	10.000	Standard	0	
2	TQ51_13DEC2011_DSP2_002	sopa1127-2_SJC_window	SOPA1127 UPLC-2	1.4	10.000	Standard	0.125	
3	TQ51_13DEC2011_DSP2_003	MMS 0.25	sopa1127-2_SJC_window	1.5	10.000	Standard	0.25	
4	TQ51_13DEC2011_DSP2_004	MMS 0.5	sopa1127-2_SJC_window	1.6	10.000	Standard	0.5	
5	TQ51_13DEC2011_DSP2_005	MMS 1	sopa1127-2_SJC_window	1.7	10.000	Standard	1	
6	TQ51_13DEC2011_DSP2_006	MeOH	sopa1127-2_SJC_window	1.8	10.000	Solvent		
7	TQ51_13DEC2011_DSP2_007	2A	sopa1127-2_SJC_window	1.2	10.000	Analyte		
8	TQ51_13DEC2011_DSP2_008	2B	sopa1127-2_SJC_window	1.9	10.000	Analyte		
9	TQ51_13DEC2011_DSP2_009	2C	sopa1127-2_SJC_window	1.10	10.000	Analyte		
10	TQ51_13DEC2011_DSP2_010	2D	sopa1127-2_SJC_window	1.11	10.000	Analyte		
11	TQ51_13DEC2011_DSP2_011	2E	sopa1127-2_SJC_window	1.12	10.000	Analyte		
12	TQ51_13DEC2011_DSP2_012	2F	sopa1127-2_SJC_window	1.13	10.000	Analyte		
13	TQ51_13DEC2011_DSP2_013	2G	sopa1127-2_SJC_window	1.14	10.000	Analyte		
14	TQ51_13DEC2011_DSP2_014	2H	sopa1127-2_SJC_window	1.15	10.000	Analyte		
15	TQ51_13DEC2011_DSP2_015	2I	sopa1127-2_SJC_window	1.16	10.000	Analyte		
16	TQ51_13DEC2011_DSP2_016	2J	sopa1127-2_SJC_window	1.17	10.000	Analyte		
17	TQ51_13DEC2011_DSP2_017	2K	sopa1127-2_SJC_window	1.18	10.000	Analyte		
18	TQ51_13DEC2011_DSP2_018	2L	sopa1127-2_SJC_window	1.19	10.000	Analyte		
19	TQ51_13DEC2011_DSP2_019	2M	sopa1127-2_SJC_window	1.20	10.000	Analyte		
20	TQ51_13DEC2011_DSP2_020	2N	sopa1127-2_SJC_window	1.21	10.000	Analyte		
21	TQ51_13DEC2011_DSP2_021	2O	sopa1127-2_SJC_window	1.22	10.000	Analyte		
22	TQ51_13DEC2011_DSP2_022	2P	sopa1127-2_SJC_window	1.23	10.000	Analyte		
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24	TQ51_13DEC2011_DSP2_024	2R	sopa1127-2_SJC_window	1.25	10.000	Analyte		
25	TQ51_13DEC2011_DSP2_025	2S	sopa1127-2_SJC_window	1.26	10.000	Analyte		
26	TQ51_13DEC2011_DSP2_026	2T	sopa1127-2_SJC_window	1.27	10.000	Analyte		
27	TQ51_13DEC2011_DSP2_027	2U	sopa1127-2_SJC_window	1.28	10.000	Analyte		
28	TQ51_13DEC2011_DSP2_028	2V	sopa1127-2_SJC_window	1.29	10.000	Analyte		
29	TQ51_13DEC2011_DSP2_029	2W	sopa1127-2_SJC_window	1.30	10.000	Analyte		
30	TQ51_13DEC2011_DSP2_030	2X	sopa1127-2_SJC_window	1.31	10.000	Analyte		
31	TQ51_13DEC2011_DSP2_031	2Y	sopa1127-2_SJC_window	1.32	10.000	Analyte		
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36	TQ51_13DEC2011_DSP2_036	2AD	sopa1127-2_SJC_window	1.37	10.000	Analyte		
37	TQ51_13DEC2011_DSP2_037	2AE	sopa1127-2_SJC_window	1.38	10.000	Analyte		
38	TQ51_13DEC2011_DSP2_038	2AF	sopa1127-2_SJC_window	1.39	10.000	Analyte		
39	TQ51_13DEC2011_DSP2_039	2AG	sopa1127-2_SJC_window	1.40	10.000	Analyte		
40	TQ51_13DEC2011_DSP2_040	2AH	sopa1127-2_SJC_window	1.41	10.000	Analyte		

# Experimental Information Multi-Residue Method

# Multi-residue Veterinary drugs Sample preparation approach



Pass through



# Multi-residue pesticides

## Sample preparation approach

### samples

#### Extraction

Measure out 10 g sample +10 mL water+ 15mL of 1% acetic acid in Acetonitrile into DisQuE tube 1



#### Centrifuge

Centrifuge and transfer 1 mL of the extraction into DisQuE tube 2



#### Centrifuge

Dilute 10 times with water (~ 15x dilution)

### Dispersion SPE



# Mycotoxins

## Sample preparation approach

Waters

THE SCIENCE OF WHAT'S POSSIBLE.®

**grain**

### Extraction

Measure out 10 g of sample+10 mL water+ 10mL of 10% acetic acid in Acetonitrile into DisQuE tube 1

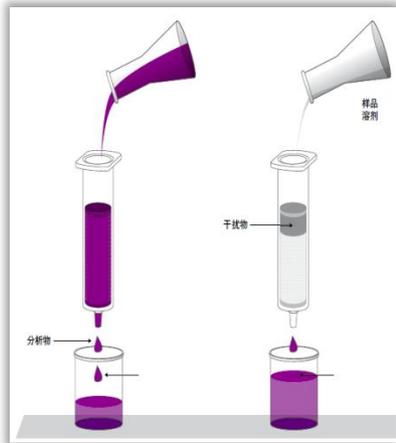
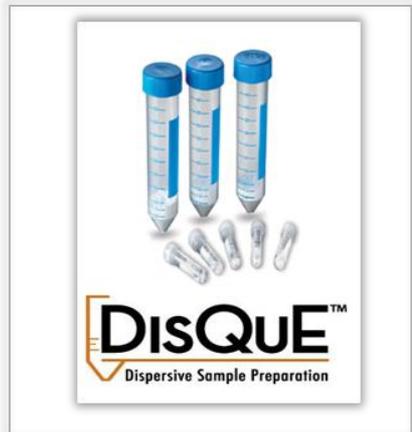


### Centrifuge

Centrifuge and transfer 1 mL of the extraction into **PRiME HLB**

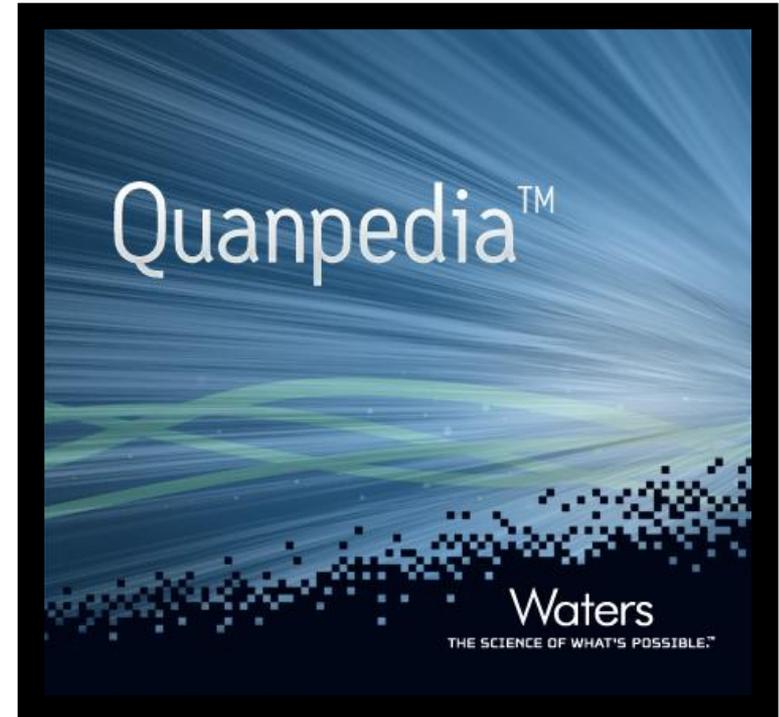


**Pass-Through SPE Cleanup**



# Instrument Conditions

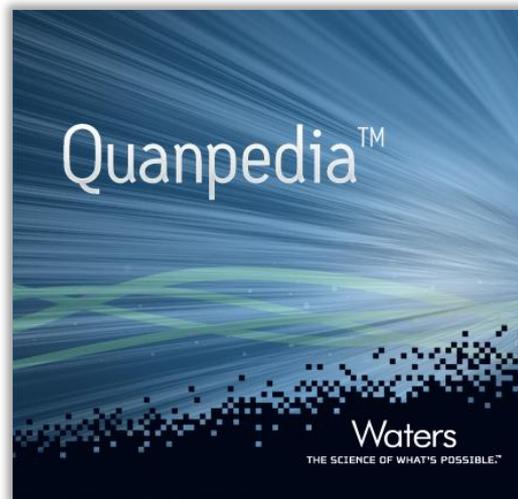
- A central data base for quantitative LC/MS methods
- Based on compound name or predefined analysis
- A tool to aid MS method creation
  - Automatically creates data **acquisition methods**
  - Automatically creates data **processing methods**



# Quanpedia database

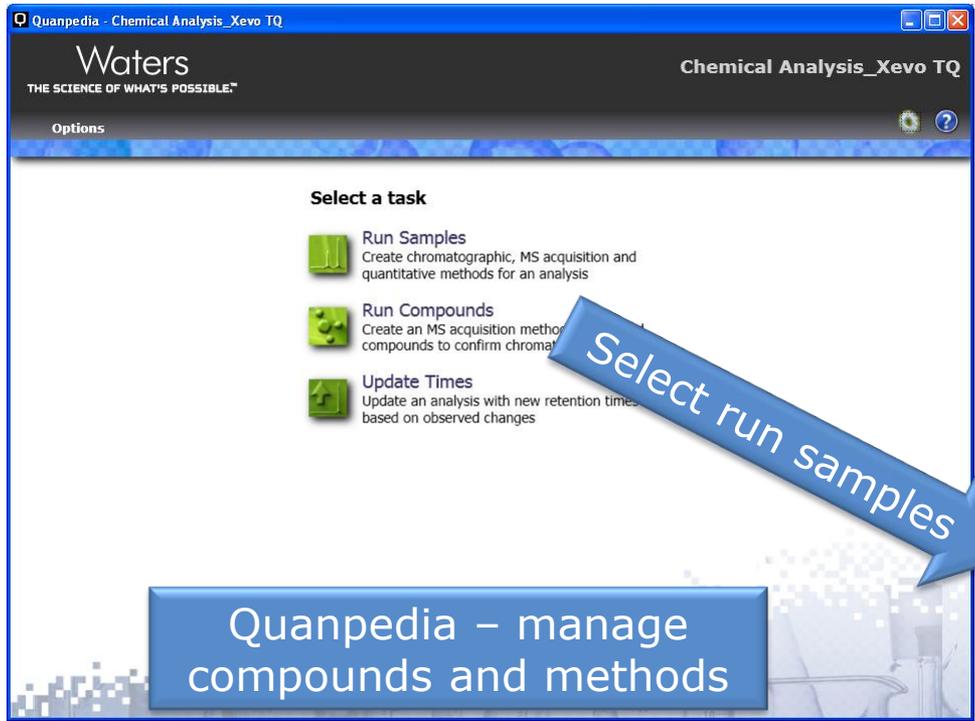
—set up & update for China customer needs

Waters  
THE SCIENCE OF WHAT'S POSSIBLE.®



- 📄 mycotoxins.qdb
- 📄 327 Pesticides Screen TQ-S.qdb
- 📄 110 vet drug Screen TQ-S.qdb

# create multi-residue methods from Quanpedia database directly



Waters  
THE SCIENCE OF WHAT'S POSSIBLE™  
Options

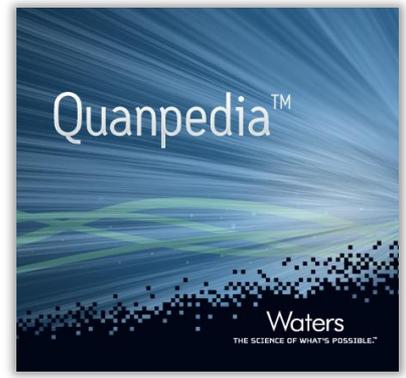
Chemical Analysis\_ Xevo TQ

Select a task

- Run Samples  
Create chromatographic, MS acquisition and quantitative methods for an analysis
- Run Compounds  
Create an MS acquisition method for compounds to confirm chromatography
- Update Times  
Update an analysis with new retention times based on observed changes

Quanpedia – manage compounds and methods

Select run samples



### Configure Analysis

Method files and a sample batch list are required to run this analysis. Enter the name to use for all the files created, the project in which they will be created and specify which files to create.

Name:

Project:

Files to create:

- MS method
- Chromatography method
- TargetLynx method
- Sample list

IntelliStart



# UPLC Conditions

- Fixed retention time based on given UPLC condition
- Should check R-T before injection sample (  $\pm 0.2 \sim 0.5$ min )

MassLynx - quanpedian - 327 pesticides\_test.spl

File View Run Help

Queue Is Empty

Spectrum Chromatogram Map Edit Samples

	File Name	Sample ID	File Text	MS File	Inlet File	Bottle
1				327 pesticides_test	327 pesticides...	

327 pesticides\_test.vwhp, 327 pesticides\_test.ft, Inlet Method

Modify ACQUITY Binary Solvent Manager Instrument Method

Acquity Binary Solvent Manager  
Ultra Performance LC

Run Time: 17.00 min

General Data Analog Out Events

Solvents

A2 water with 10mM NH4

B2 MeOH with 10mM NH4

Pressure Limits

Low: 0 psi

High: 0 psi

Seal Wash: 5.0 min

Gradient:

	Time (min)	Flow (mL/min)	%A	%B	Curve
1	Initial	0.450	98.0	2.0	Initial
2	0.25	0.450	98.0	2.0	6
3	12.25	0.450	1.0	99.0	6
4	13.00	0.450	1.0	99.0	6
5	13.01	0.450	98.0	2.0	6
6	17.00	0.450	98.0	2.0	6

Comment:

OK Cancel

Ready No Instrument 0:0 Shutdown Disabled

# MRM Conditions

## — completely pre-defined analysis

Experiment Setup - c:\masslynx\_data\quanpedia\_pesticide.pro\acqddb\screening 402 pesticides tqd.exp

File Edit View Options Toolbars Functions Help

SIR MRM MS Scan Parents Daughters Neutral Loss Survey

Points Per Peak: 4.717

Total Run Time: 8.50

No.	Type	Information	Time
1	MRM	MRM of 14 mass pairs, Time 0.00 to 2.20, ES+	
2	MRM	MRM of 17 mass pairs, Time 1.70 to 2.95, ES+	
3	MRM	MRM of 7 mass pairs, Time 2.70 to 3.15, ES+	
4	MRM	MRM of 18 mass pairs, Time 3.05 to 3.50, ES+	
5	MRM	MRM of 15 mass pairs, Time 3.40 to 4.10, ES+	
6	MRM	MRM of 19 mass pairs, Time 4.00 to 4.45, ES+	
7	MRM	MRM of 11 mass pairs, Time 4.20 to 4.55, ES+	
8	MRM	MRM of 18 mass pairs, Time 4.40 to 4.75, ES+	
9	MRM	MRM of 18 mass pairs, Time 4.55 to 5.05, ES+	
10	MRM	MRM of 22 mass pairs, Time 4.75 to 5.20, ES+	
11	MRM	MRM of 8 mass pairs, Time 4.95 to 5.30, ES+	
12	MRM	MRM of 18 mass pairs, Time 5.15 to 5.45, ES+	
13	MRM	MRM of 14 mass pairs, Time 5.45 to 5.65, ES+	
14	MRM	MRM of 24 mass pairs, Time 5.65 to 6.05, ES+	
15	MRM	MRM of 12 mass pairs, Time 5.85 to 6.25, ES+	
16	MRM	MRM of 9 mass pairs, Time 5.95 to 6.35, ES+	
17	MRM	MRM of 20 mass pairs, Time 5.95 to 6.35, ES+	
18	MRM	MRM of 16 mass pairs, Time 6.05 to 6.35, ES+	
19	MRM	MRM of 7 mass pairs, Time 6.15 to 6.45, ES+	
20	MRM	MRM of 26 mass pairs, Time 6.25 to 6.65, ES+	
21	MRM	MRM of 30 mass pairs, Time 6.40 to 6.80, ES+	
22	MRM	MRM of 16 mass pairs, Time 6.70 to 7.05, ES+	
23	MRM	MRM of 7 mass pairs, Time 6.75 to 6.90, ES+	
24	MRM	MRM of 18 mass pairs, Time 6.90 to 7.30, ES+	
25	MRM	MRM of 14 mass pairs, Time 7.10 to 7.50, ES+	
26	MRM	MRM of 9 mass pairs, Time 7.35 to 8.50, ES+	

Experiment Setup - c:\masslynx\default.pro\acqddb\baby food pesticides.exp

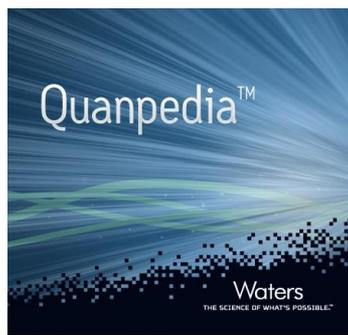
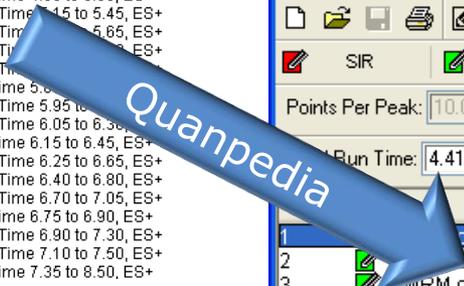
File Edit View Options Toolbars Functions Help

SIR MRM MS Scan Parents Daughters Neutral Loss Survey ScanWave MS

Points Per Peak: 10.061

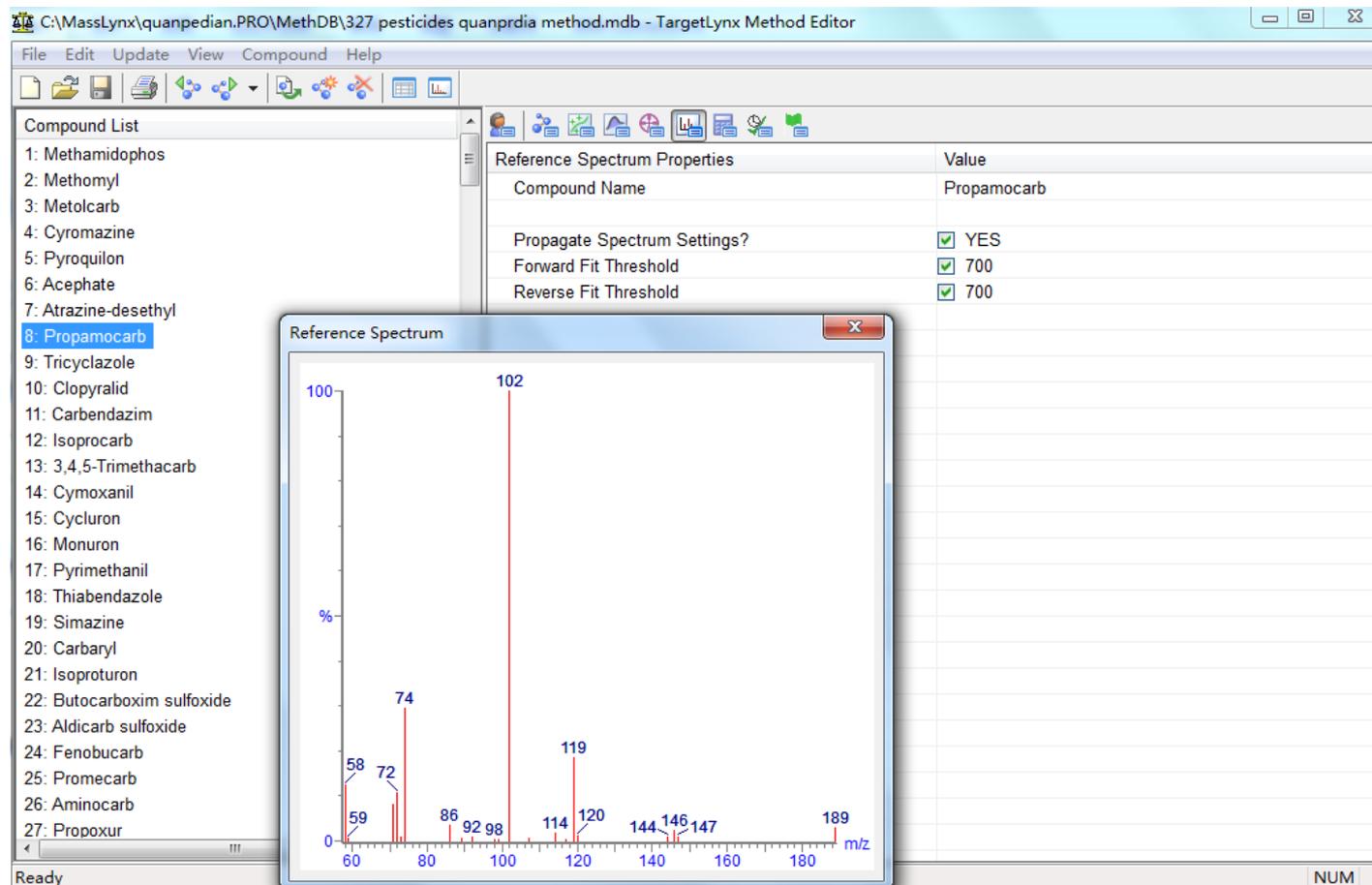
Total Run Time: 4.41

No.	Type	Information	Time
1	MRM	MRM of 2 mass pairs, Time 0.84 to 1.10, ES+ (Omethoate)	
2	MRM	MRM of 2 mass pairs, Time 1.67 to 1.92, ES+ (Dimethoate)	
3	MRM	MRM of 2 mass pairs, Time 2.50 to 2.75, ES+ (Demeton-S-met)	
4	MRM	MRM of 2 mass pairs, Time 3.56 to 3.81, ES+ (Ethoprophos)	
5	MRM	MRM of 2 mass pairs, Time 1.23 to 1.48, ES+ (Oxydemeton-met)	
6	MRM	MRM of 2 mass pairs, Time 1.26 to 1.51, ES+ (Demeton-S-met)	
7	MRM	MRM of 2 mass pairs, Time 3.96 to 4.21, ES+ (Cadusafos)	
8	MRM	MRM of 2 mass pairs, Time 3.90 to 4.16, ES+ (Disulfoton)	
9	MRM	MRM of 2 mass pairs, Time 4.16 to 4.41, ES+ (Terbufos)	
10	MRM	MRM of 2 mass pairs, Time 2.81 to 3.06, ES+ (Disulfoton-sulfox)	
11	MRM	MRM of 2 mass pairs, Time 2.19 to 2.44, ES+ (Fensulfothion ox)	
12	MRM	MRM of 2 mass pairs, Time 3.19 to 3.44, ES+ (Terbufos-sulfoxi)	
13	MRM	MRM of 2 mass pairs, Time 2.86 to 3.11, ES+ (Disulfoton-sulfon)	
14	MRM	MRM of 2 mass pairs, Time 2.98 to 3.23, ES+ (Fensulfothion)	
15	MRM	MRM of 2 mass pairs, Time 2.27 to 2.52, ES+ (Fensulfothion ox)	
16	MRM	MRM of 2 mass pairs, Time 3.17 to 3.42, ES+ (Terbufos-sulfone)	



# Data processing methods include PICs reference spectrum

- Acquire all compounds' PICs reference spectrum and predefined in Quanpedia database





# Results and Conclusions

[APPLICATION NOTE]

## Rapid Detection of Pesticide Residues in Fruit Juices Without Sample Extraction Using UPLC-MS/MS

Dimple Shah, Jinchuan Yang, Gordon Fujimoro, Lauren Mullin, and Jenn Waters Corporation, Milford, MA, USA

### APPLICATION BENEFITS

Pesticides can be detected below legislative limits in fruit juices using a "dilute and shoot" approach with the ACQUITY UPLC® I-Class System coupled to the Xevo® TQ-S Mass Spectrometer.

- Ultra-sensitive Xevo TQ-S facilitates trace level detection of pesticides.
- Dilute and shoot approach reduces sample preparation time and improves laboratory efficiency.
- Dilute and shoot approach provides excellent repeatability.
- Simple QuEChERS extraction can be employed prior to dilution for complex matrices.

### WATERS SOLUTIONS

ACQUITY UPLC I-Class System  
Xevo TQ-S Mass Spectrometer  
ACQUITY UPLC BEH Column  
Masslynx™ Software  
Quanpedia™ Database  
DtsQuE™ Sample Preparation Kit

### KEY WORDS

Pesticides, fruit juice, MS, Quanpedia, QuEChERS, food safety, carbendazim, rotenone

[APPLICATION NOTE]

## A Simple Cleanup Protocol for Analysis of Multi-Residue Veterinary Drugs in Milk

DeFeng Huang, Kim Van Tran, and Michael Waters Technologies, Ltd., Shanghai, China

### APPLICATION BENEFITS

- Enable simultaneous determination of multi-class of veterinary drugs using an innovative solid phase extraction device
- Simple, fast, pass-through SPE cleanup prior to UPLC-MS/MS analysis
- The matrix interference from fatty acid materials and phospholipids are removed together in one straightforward SPE cleanup for longer column life and less maintenance of the mass spectrometer

### INTRODUCTION

Pesticide residues especially taking in report concerning the widespread fruits in the United States (FDA) began testing

Many published methods for regulatory purposes in order to use technologies, name screening methods multi-residue analysis



Figure 1. Partial list of

### WATERS SOLUTIONS

ACQUITY UPLC® I-Class System  
Xevo® TQ-S Mass Spectrometer  
ACQUITY UPLC BEH C<sub>18</sub> Column  
Oasis® PRIME HLB 3 cc 60 mg cartridge  
TriView™ LCMS Certified Vials  
Masslynx® v4.1 data system with Quanpedia™ database

### KEY WORDS

Oasis PRIME HLB, multi-residue, veterinary drug, SPE, milk, UPLC-MS/MS

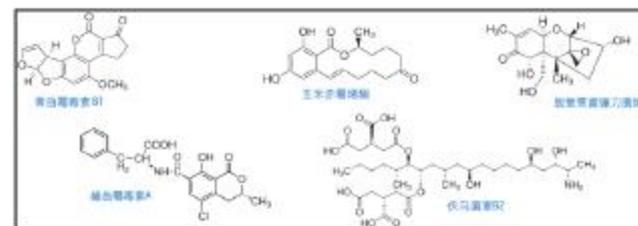


## 1 简介

### 1.1 应用背景

霉菌毒素是由霉菌或真菌产生的存在于动物食品或其他人类消费的食品上的有毒化合物，摄入的食物中即使仅含十亿分之一浓度的霉菌毒素也有可能引发严重疾病。因此，我们需要灵敏可靠的分析方法来确定食品和饲料中的霉菌毒素。下文简要介绍了一些重要的霉菌毒素种类，图 1 展示了一些重要霉菌毒素的结构。

图 1. 一些重要的真菌毒素



黄曲霉毒素：被世界卫生组织（WHO）的癌症研究机构判定为 1 类致癌物，是毒性最强、危害最大的一类霉菌毒素，接触后可能引发肝癌、生殖问题、贫血症、免疫系统抑制和黄疸等疾病。GB 2761-2011 规定黄曲霉毒素 B1 在谷物类食品中的限值为 5.0µg/kg。

伏马菌素：伏马菌素 B1 最为常见，玉米是最易受其感染的作物，接触后可能导致摄食量和体重减少、肝损伤以及肺水肿。伏马菌素还是潜在致毒物。FDA 指导原则规定人类摄入的食品中伏马菌素总量的限值为 2µg/kg。中国尚未针对食品中的 OTA 水平建立相关规定。

# China GB Methods for multi-residue Veterinary Drug Analysis for example

Method	Analytes	Sample Matrix
GB/T22286	$\beta$ -Adrenergic agonists	Muscle      respectively
GB/T21315	$\beta$ -Lactam	Kidney and muscle
GB/T22338	Chloramphenicol	Muscle
GB/T20762	Macrolide	Liver, kidney, and muscle
GB/T21316	Sulfonamides	Liver and muscle
GB/T20366	Fluoroquinolone	Liver and muscle

Combined



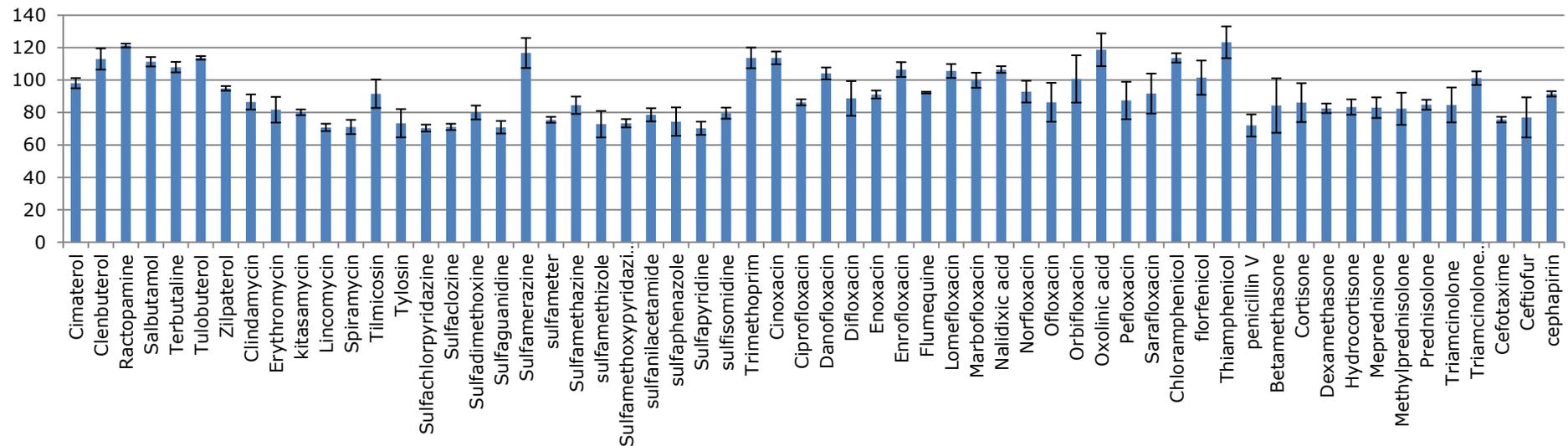
Using Oasis PRiME HLB

-Enable multi-class compounds to be analyzed using one sample prep method.

Using Oasis Xevo TQ-S with Quanpedia database

-Enable multi-class compounds to be analyzed by one injection.

# Recovery of Multi-residue Veterinary from Milk (80 compounds in 9 drug classes)



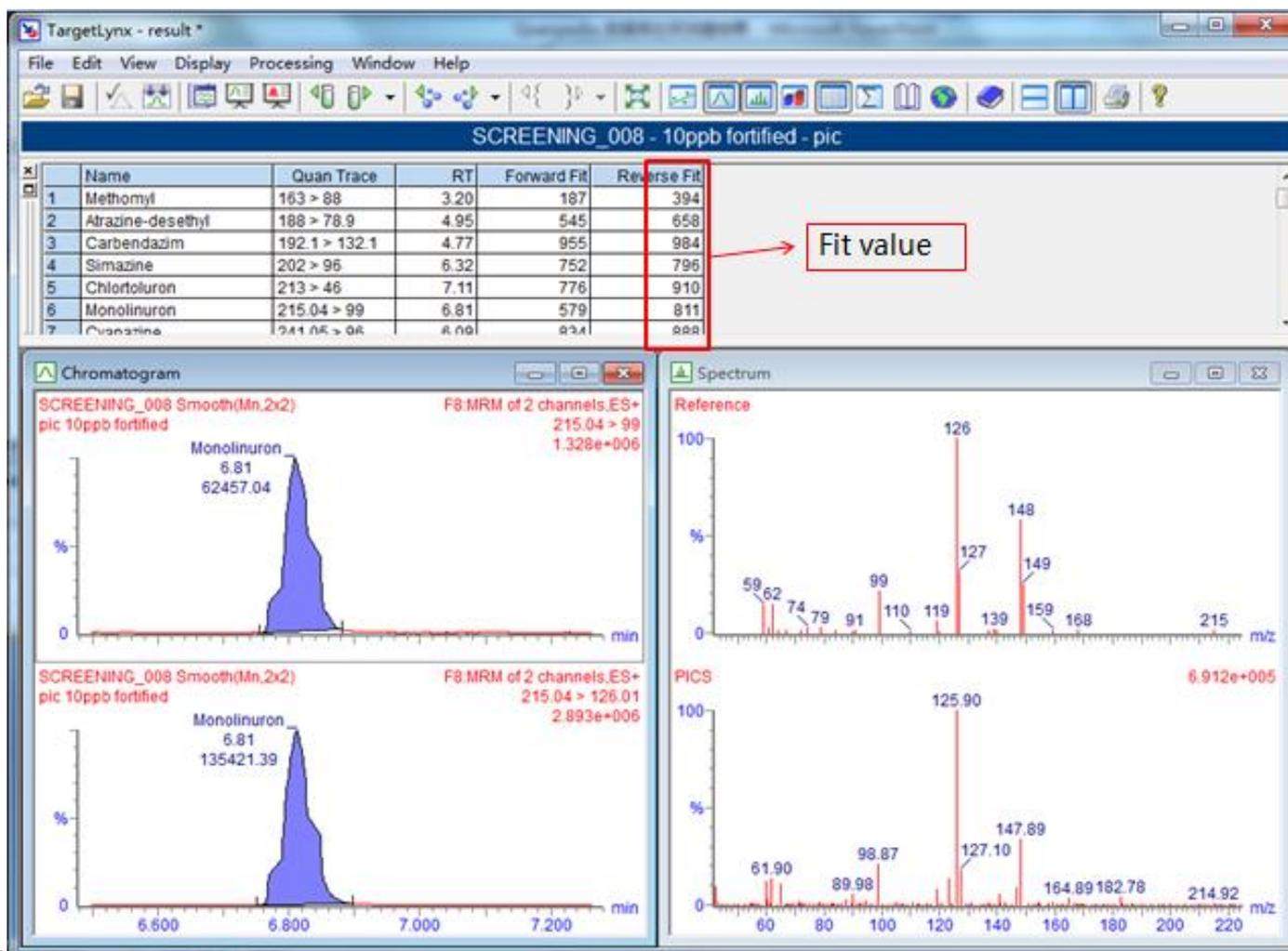
*One single method replaces 9 separate methods!!!*

Excellent recoveries ranging from 50% to 130% with precision (RSD) < 20% (n=5) for all compounds (Average recovery 91%, %RSD @ 6 (n=5))

***Recovery values are a subject to the initial milk extraction efficiency***

# TargetLynx Reporting

- Predefined PICs reference spectrum make less false positive results
- Extended application of target screening



## Conclusions

- Variety of different multi-residue solution include pesticides, Veterinary drugs and mycotoxins have been created.
- Simple sample preparation approach and Quanpedia database make customer easier to use the solution.
- Predefined PICs reference spectrum makes less false positive results.



谢谢！