QDA analysis in pesticide formulations

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**EURL**
- So called 96/23 legislation: Hormones
- Mycotoxins and plant toxins

**NRL for >20 other subjects**
- Pesticides (4x)
- Heavy metals
- GMO
- Contaminants (Dioxins, PAHs)
- and so on..
Overview

- PPP control: Four fingers approach
- Non chromatographic based methods
- Chromatographic based methods
- QDA analysis
- Summary & conclusions
PPP full product control

- DG SANTE ("FVO") audit
- Full product control
- Not possible due to lack of
  - Methods
  - Reference materials
  - (direct access to dossier)
- What’s next?

Four fingers approach
Four screening methods:
- FTIR
- NMR
- GC-MS
- LC-MS

Comparison against:
- Original products
- Actives (pure compounds)
- Other compounds like modifiers, etc. (if available)

Algorithm development

RESULT: THUMBS UP or THUMBS DOWN
Examples

Nicosulfuron (OD)
- Herbicide
- $C_{15}H_{18}N_6O_6S$
- 410.4 g/mol

Methoxyfenozide (SC)
- Insecticide
- $C_{22}H_{28}N_2O_3$
- 368.5 g/mol

Pencycuron (SC)
- Fungicide
- $C_{19}H_{21}ClN_2O$
- 328.8 g/mol

Four fingers: 1. FTIR

- Infrared spectroscopy gives information about the vibration frequencies within a molecule
- Mid infrared $\lambda = 2.5-25 \, \mu m$ or $4000-400 \, \text{cm}^{-1}$
- Complicated spectra, specialist interpretation needed
- Sample can be applied “as is”.

Example FTIR

Three batches nicosulfuron PPP
Example FTIR

Nicosulfuron (PPP)  Nicosulfuron reference
Example FTIR

Three batches parallel PPP (methoxyfenozide)
Isotopes that contain an odd number of protons and/or neutrons

Most common $^1$H or $^{13}$C; $^{31}$P.

Proton NMR most sensitive (use deuterated solvents)

It gives information about the “surroundings” of an atom in a molecule: molecular structure.
Example NMR

Three batches nicosulfuron
Example NMR

Nicosulfuron based PPP after addition of neat material

Nicosulfuron based PPP
Four fingers: 3. GC-MS

- Under development
Four fingers: 4. QDA

Source: Waters

Chiral and Achiral Profiling of a Pesticide Formulation Using the ACQUITY UPC2 System and the ACQUITY QDa Detector
Nicosulfuron based PPP (OD)

UV chromatogram (full scan)

MS chromatogram (full scan)
Nicosulfuron based PPP (OD)
Nicosulfuron Quantitation

Nicosulfuron PDA

Nicosulfuron MS

Calculated 63 g/l ± 0.32%

Calculated 100 g/l ± 60%

Target 60 g/l (54-66 g/l)
Pencycuron quantitation

Calculated 257 g/l ± 1.0%  
Calculated >1000 g/l ± 16%  

Target 250 g/l (235-265 g/l)
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Other MS findings

Abamectin based EC
Polyethoxylated castor oil (POE (20))

-CH₂-CH₂-O- (M = 44)
QDA summary

- MS
  - Active substance identification possible
  - Other compounds when reference is available
  - Quantitation more difficult
  - Development continues

- Diode-array
  - Assists with identification, not very specific
  - Good quantification parameters
Summary & Conclusions

The Four Fingers approach gives the maximum amount of product information and would be suited for product control without the need of analysis of all individual compounds.
Thank you for your attention!