A photograph of a laboratory rack containing several small glass vials with blue caps. Some vials contain a yellow liquid, while others are empty. The rack is white and the background is a blurred laboratory setting.

# **SPLITLESS LINERS IN GAS CHROMATOGRAPHY**

**Inertia, durability and performance**

**Online videotutorial**

María Murcia Morales  
Amadeo R. Fernández-Alba



**EURL-FV**



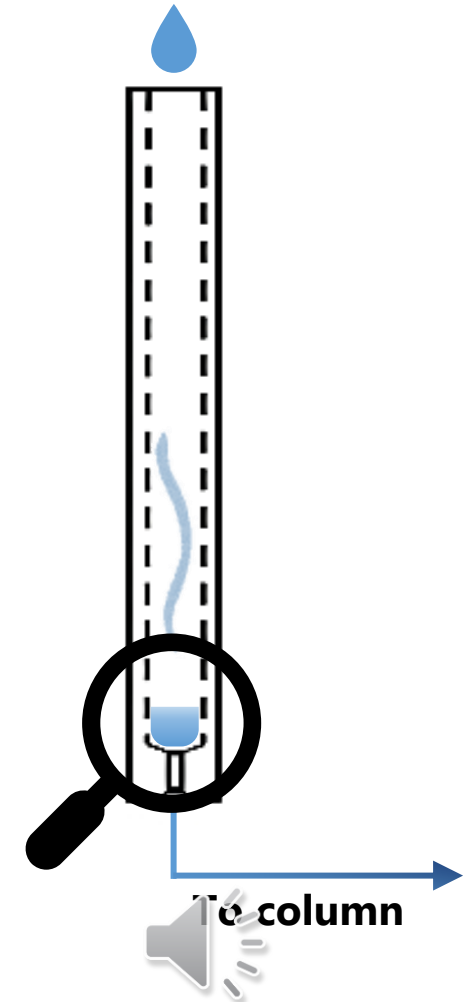
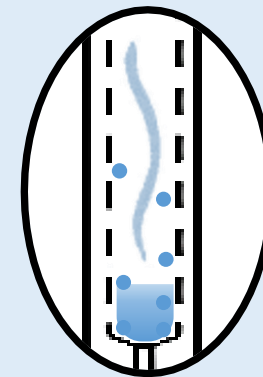
In gas chromatography, samples are typically injected in liquid state and turned into **gas state** in the injector

## Liner

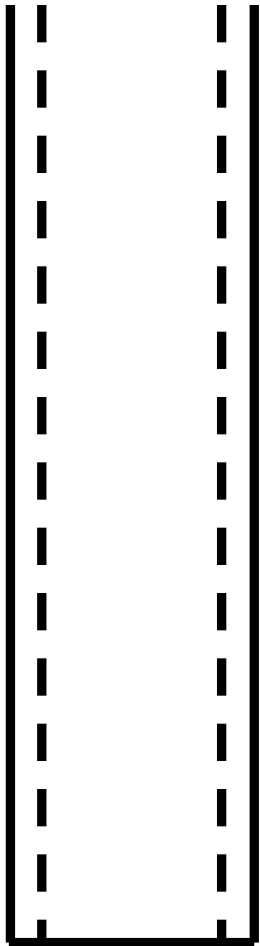


A large number of liner references with **different configurations** is offered by specialized companies

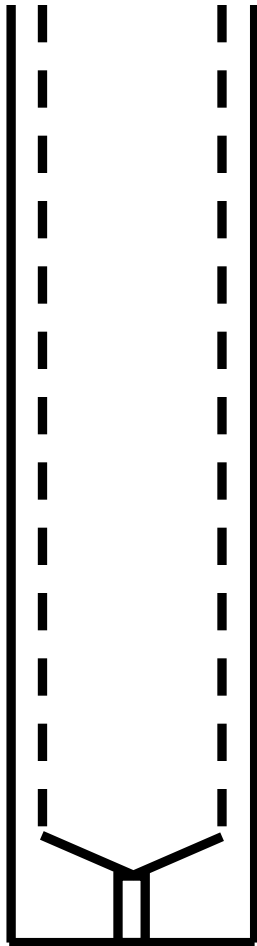
Liners possess **active sites** in which some sample components can be retained; each manufacturer employs a specific deactivation methodology



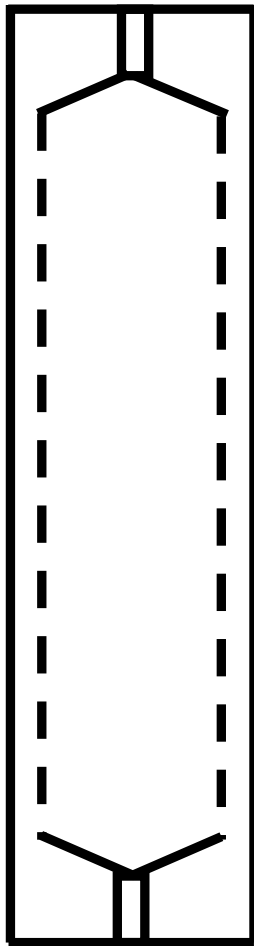
## Geometry



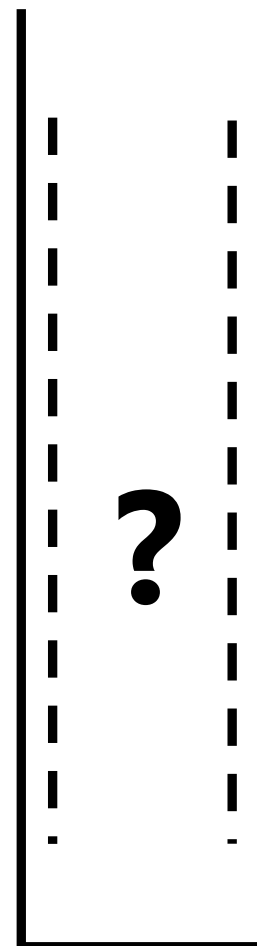
Straight



Single taper



Double taper



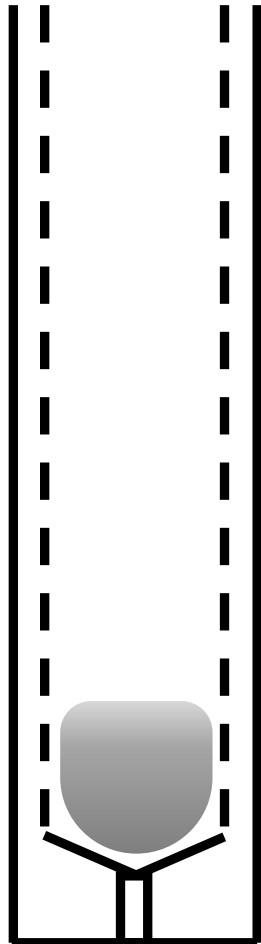
Especial  
geometry

Tapers may help in

1. Minimizing the interactions of the sample components with the inlet
2. Focusing the analytes to the column
3. Reducing the loss of matrix components during the evaporation (double taper)



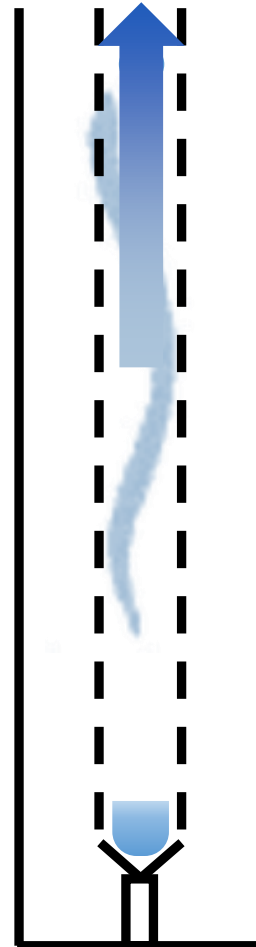
## Packing



### Glass wool or frit

- ✓ Provides a support for the sample during the evaporation
- ✓ Prevents the non-volatile components from reaching the column
- ✗ Might interact with some labile analytes
- ✗ Defective packing might result in loss of reproducibility


## Internal diameter



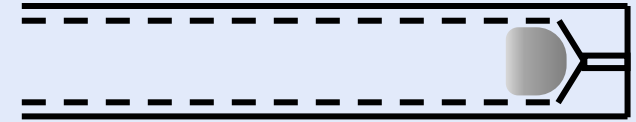
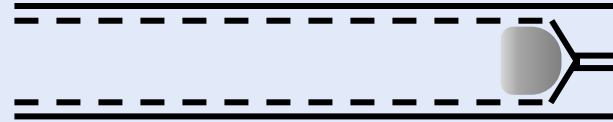
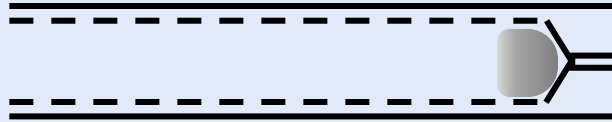
### Reduced internal diameter

- ✓ Helps transfer the sample to the column in a narrow band (increased gas velocity)
- ✗ The maximum capacity should be carefully considered

**Deactivation**  
**Geometry**  
**Packing**  
**Internal diameter**

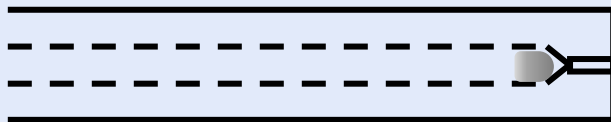


## Liners # 1-2-3



Single taper, glass wool, three companies (deactivation processes)

## Liner # 4



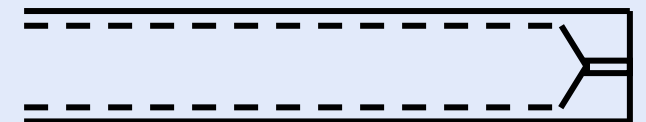
Reduced **internal diameter**

## Liner # 5



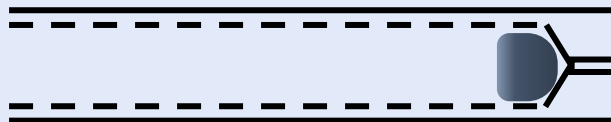
**Special geometry** (cyclo)

## Liner # 6



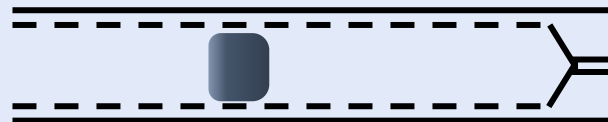
**No packing**

## Liner # 7



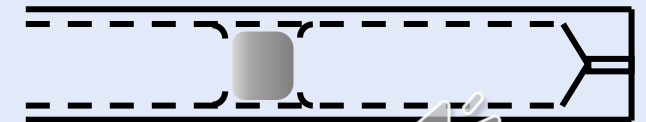
Glass **frit**

## Liner # 8



Glass frit, **medium position**

## Liner # 9



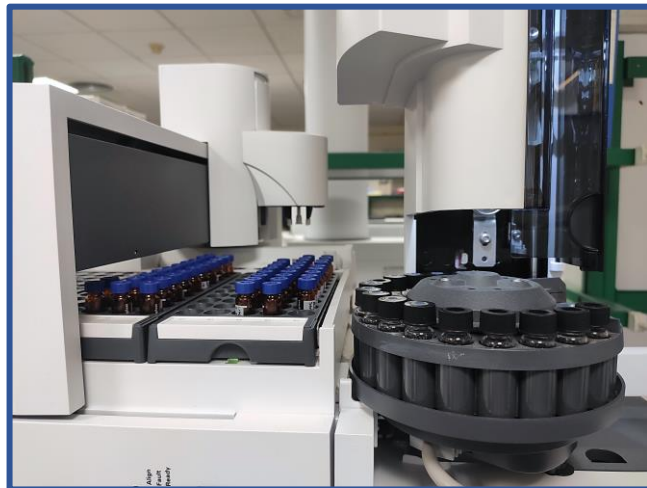
**Tapered** glass wool, medium position



## Intuvo 9000 GC system (Agilent)

- Injection mode: Splitless
- Sample injection volume: 1  $\mu\text{L}$  (EtAc)
- Inlet temperature:
  - 80 °C (for 0.1 min),
  - up to 300 °C at 600 °C/min
- Oven T°:
  - 60 °C for 0.5 min,
  - up to 170 °C (80 °C/min),
  - up to 310 °C (20 °C/min, hold for 3.5 min)
- Post Run: 2.1 min, 310 °C

Estimated volume  
after evaporation:  
**140  $\mu\text{L}$**



## 7410 triple quadrupole system (Agilent)

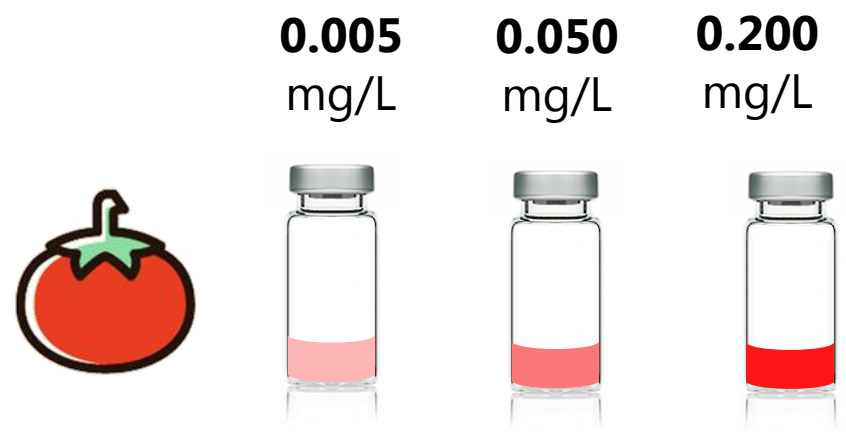
- Ionisation mode: electron impact ionization
- T° transfer line and ion source: 280 °C
- Collision gas: nitrogen
- Solvent delay: 2.6 min



## Signal intensity

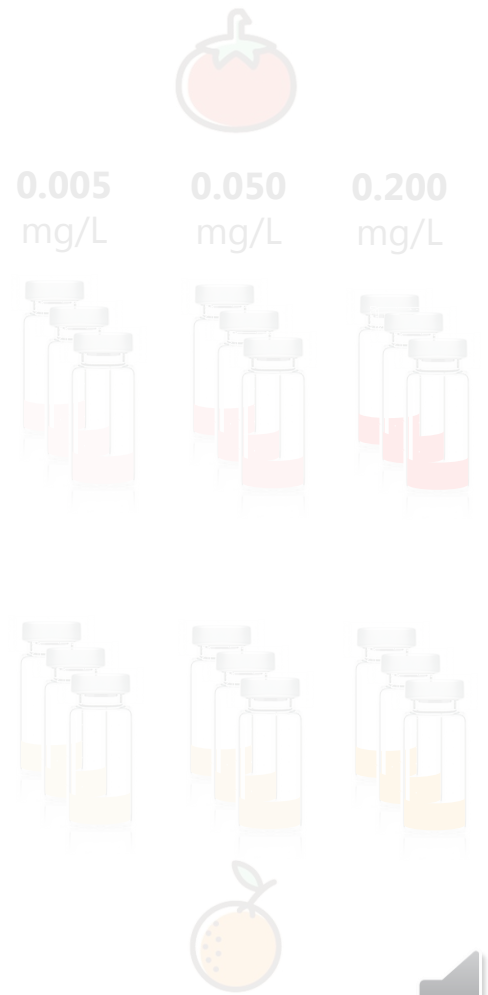
Liner # 1 was selected as the **reference**. Each day, a new liner # 1 was placed in the inlet and three reference injections were performed

### 188 pesticide residues in ethyl acetate



## Durability and peak shapes

- 0.005 Tomato (x4)
- 0.050 Tomato (x4)
- 0.200 Tomato (x4)
  
- 0.005 Orange (x4)
- 0.050 Orange (x4)
- 0.200 Orange (x4)
  
- 0.005 Tomato (x4)
- 0.050 Tomato (x4)
- 0.200 Tomato (x4)



[...]

72 injections





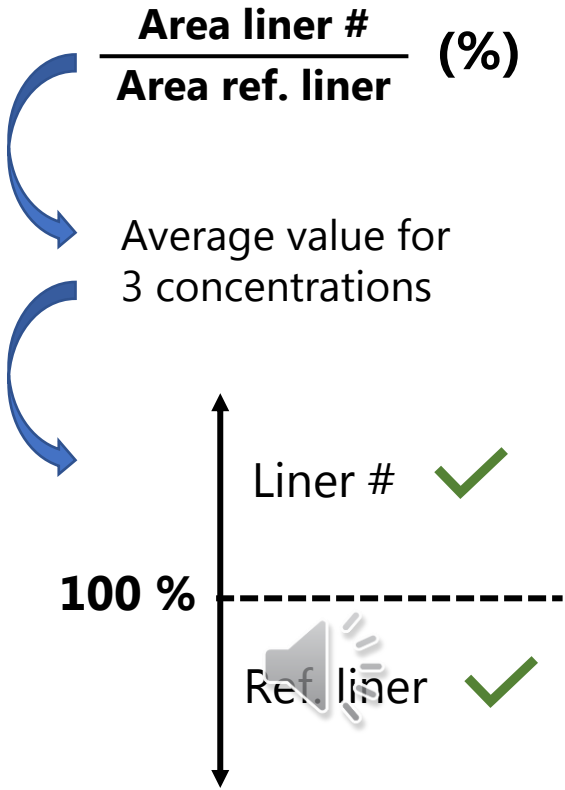


# SIGNAL INTENSITY

Liner # 1 was selected as the **reference**. Each day, a new liner # 1 was placed in the inlet and three reference injections were performed (**tomato matrix** 🍅)

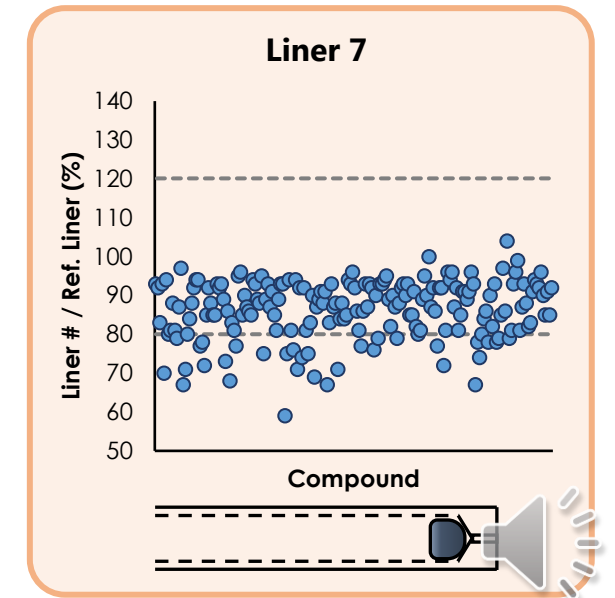
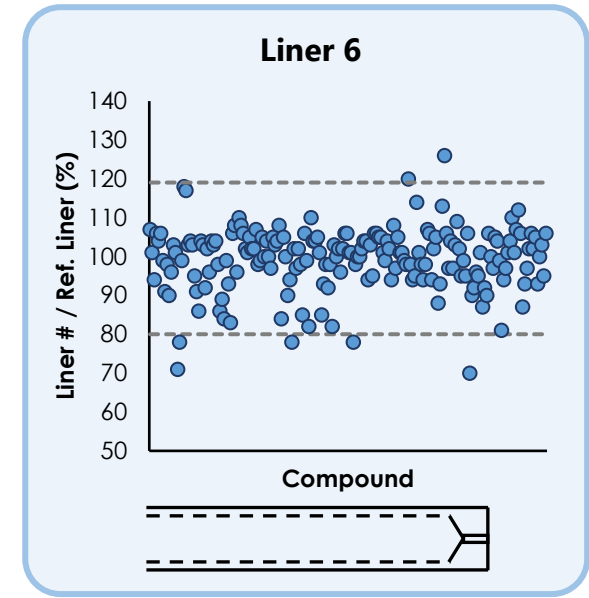
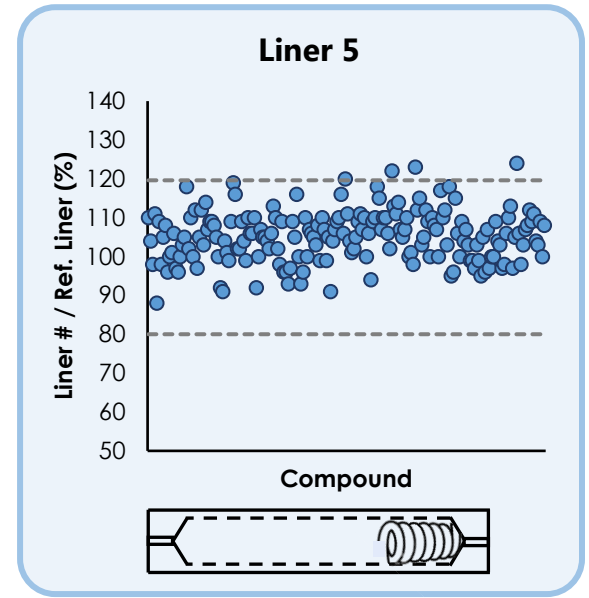
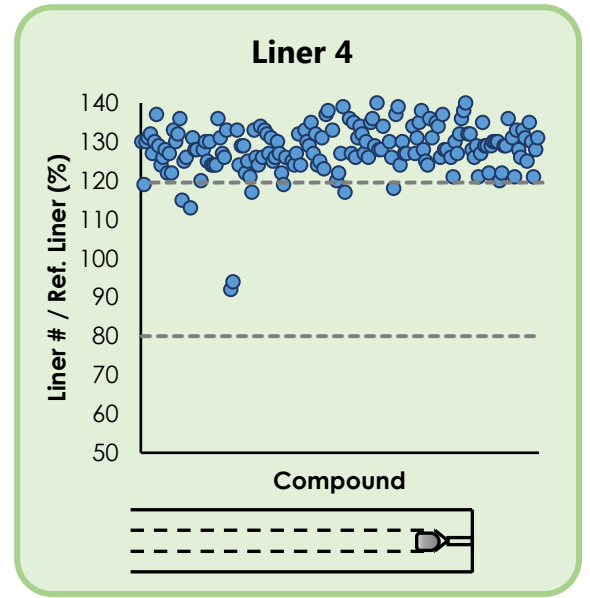
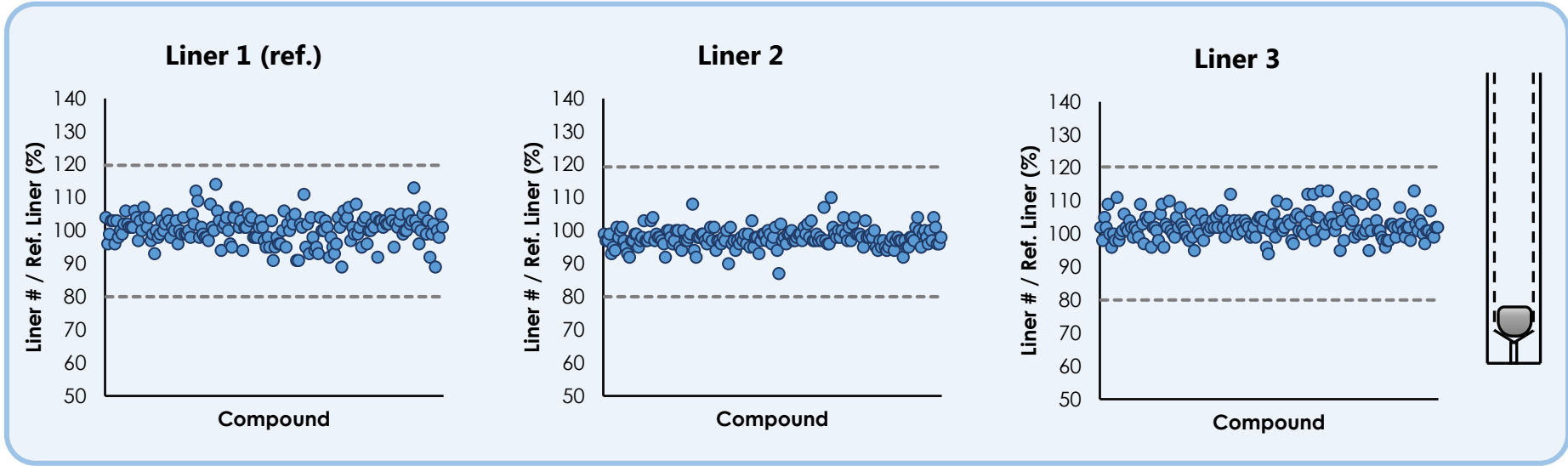


- SEQUENCE**
- Reference liner (new)*
    1. Tomato 0.005 mg/L
    2. Tomato 0.050 mg/L
    3. Tomato 0.200 mg/L
  - New liner #*
    4. Tomato 0.005 mg/L
    5. Tomato 0.050 mg/L
    6. Tomato 0.200 mg/L
    7. [...]

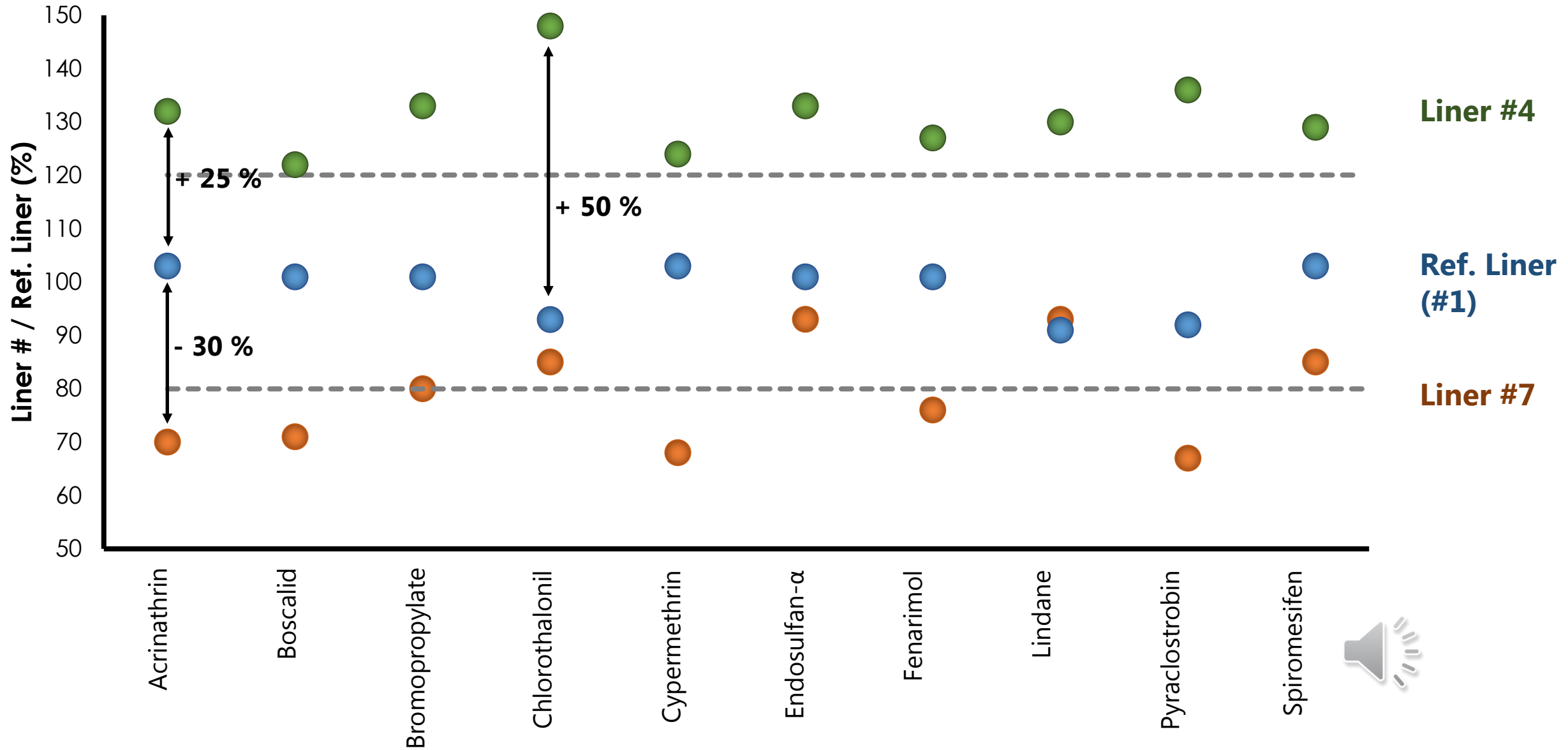




$$\frac{\text{Area liner \#}}{\text{Area ref. liner}} (\%)$$



# SIGNAL INTENSITY



## Signal intensity

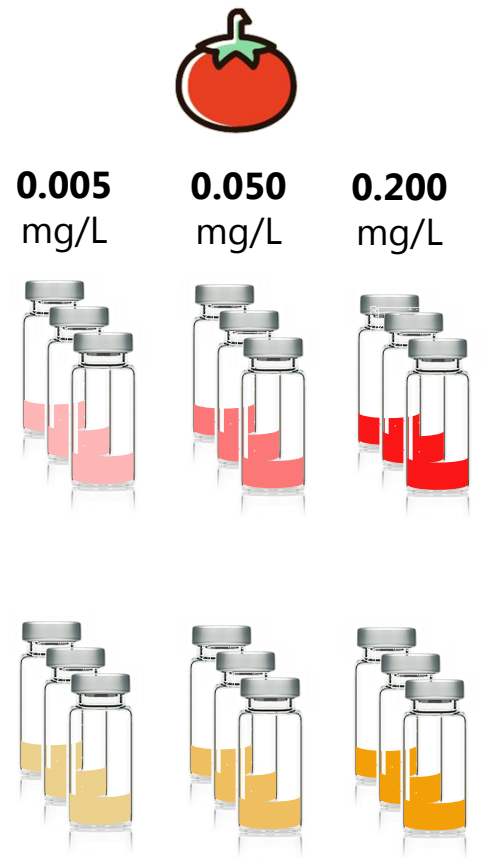
Liner # 1 was selected as the **reference**. Each day, a new liner # 1 was placed in the inlet and three reference injections were performed

### 188 pesticide residues in ethyl acetate



## Durability and peak shapes

- 0.005 Tomato (x4)
- 0.050 Tomato (x4)
- 0.200 Tomato (x4)
  
- 0.005 Orange (x4)
- 0.050 Orange (x4)
- 0.200 Orange (x4)
  
- 0.005 Tomato (x4)
- 0.050 Tomato (x4)
- 0.200 Tomato (x4)



[...]

**72 injections**





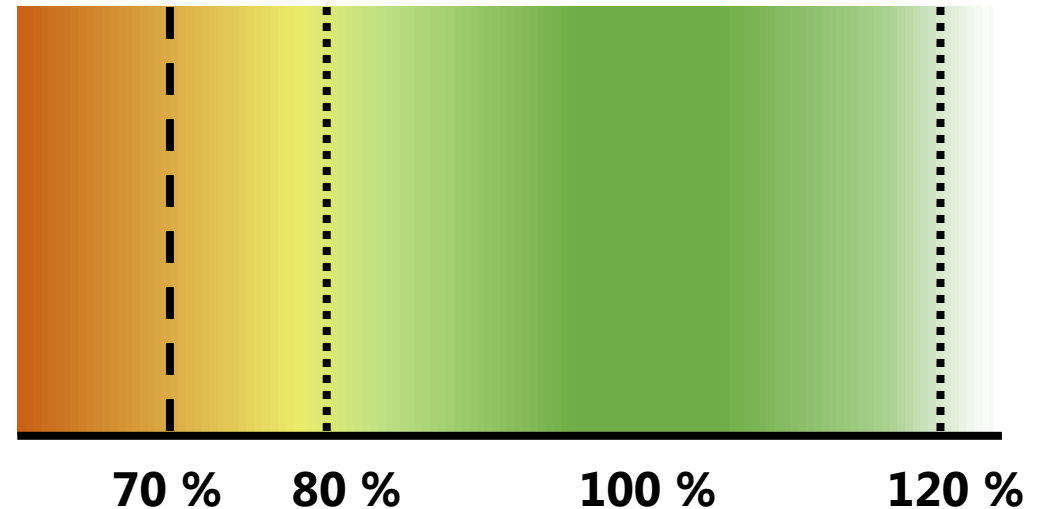
# DURABILITY

Difference between areas of the **1<sup>st</sup>** and **51<sup>th</sup>** injection

**2** matrices (tomato, orange)

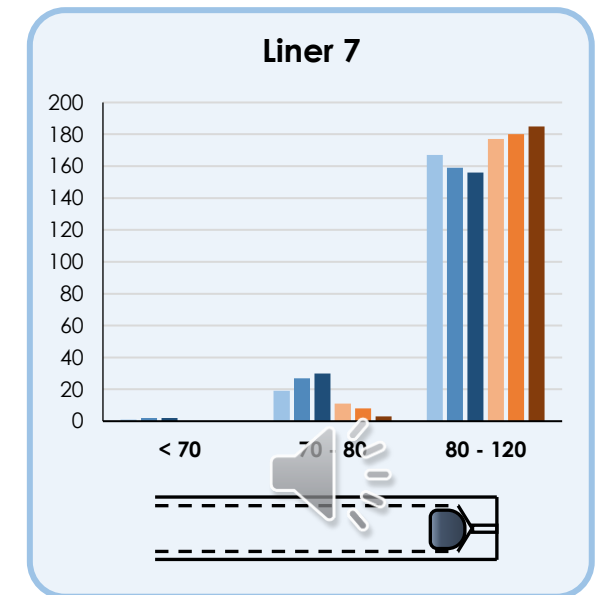
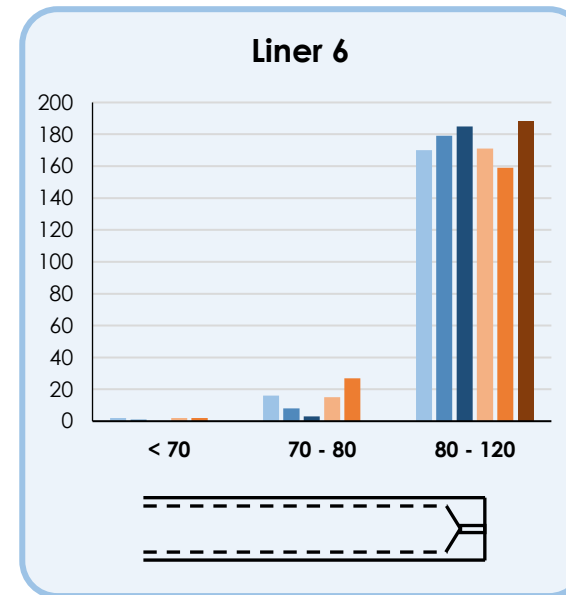
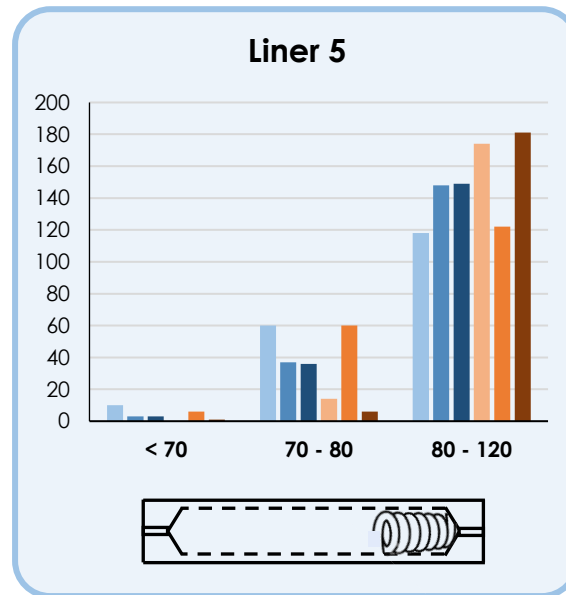
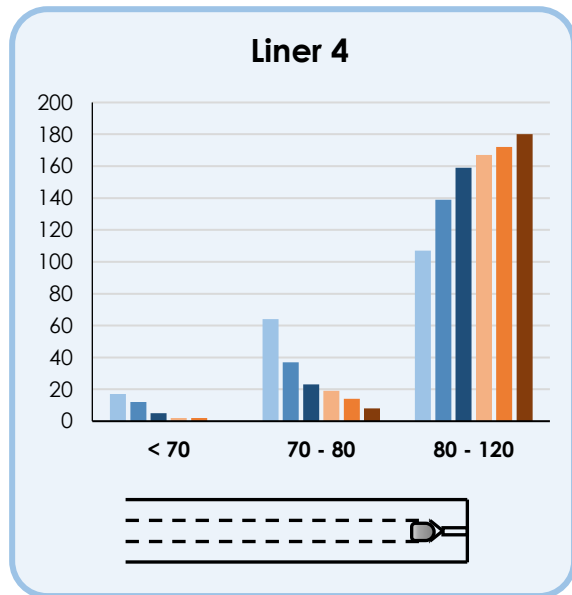
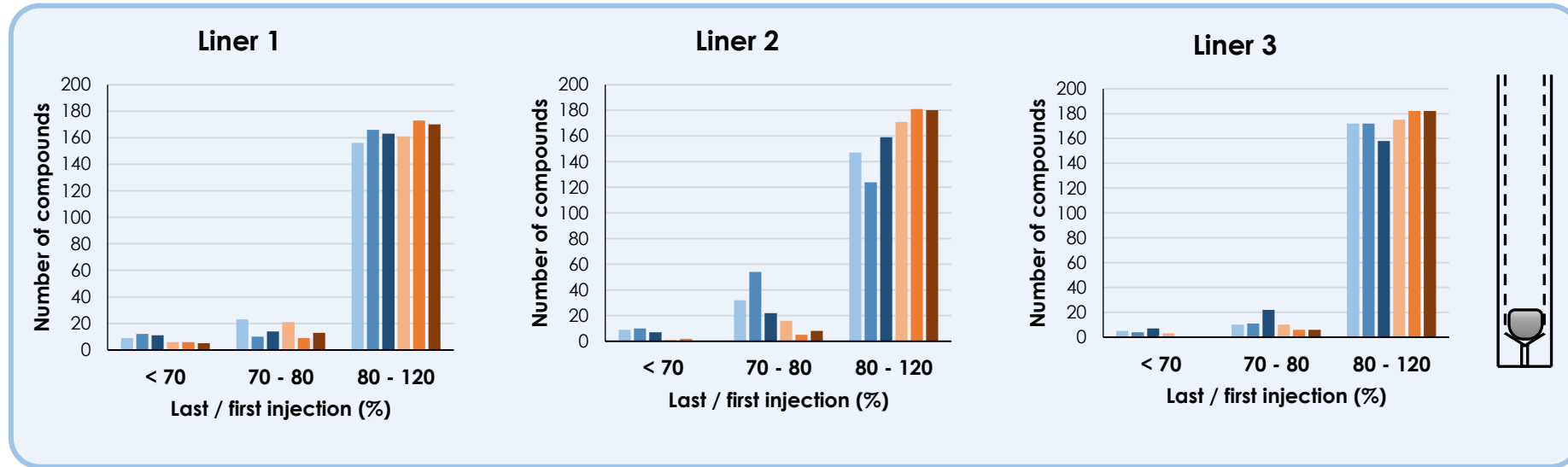
**3** concentration levels  
(0.005, 0.050, 0.200 mg/L)

Area after 51 injections  
Area first injection (%)



Area after 51 injections  
Area first injection

	Tomato 0.005 mg/L
	Tomato 0.050 mg/L
	Tomato 0.200 mg/L
	Orange 0.005 mg/L
	Orange 0.050 mg/L
	Orange 0.200 mg/L

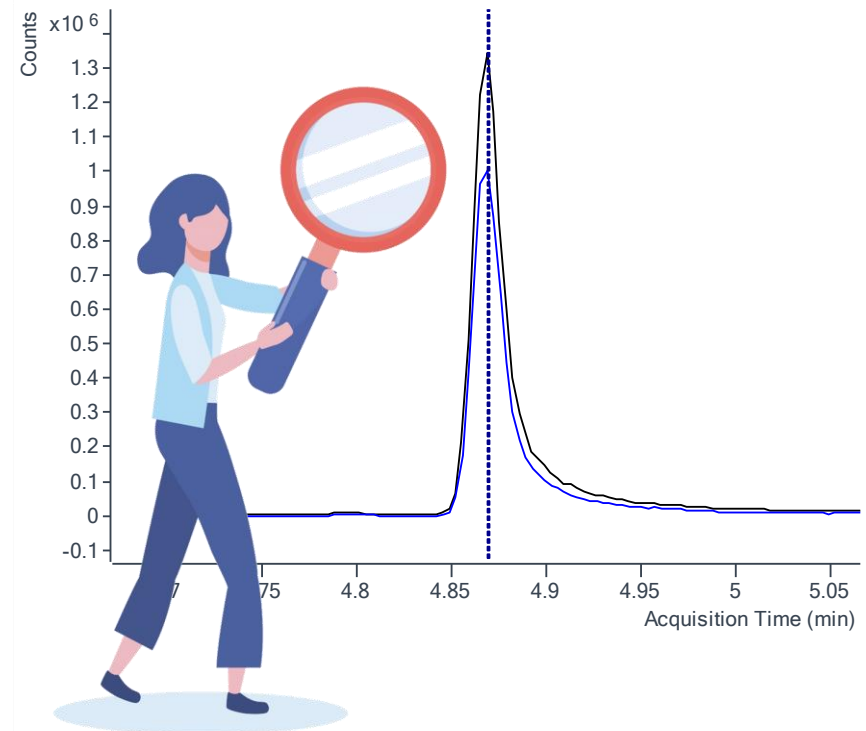




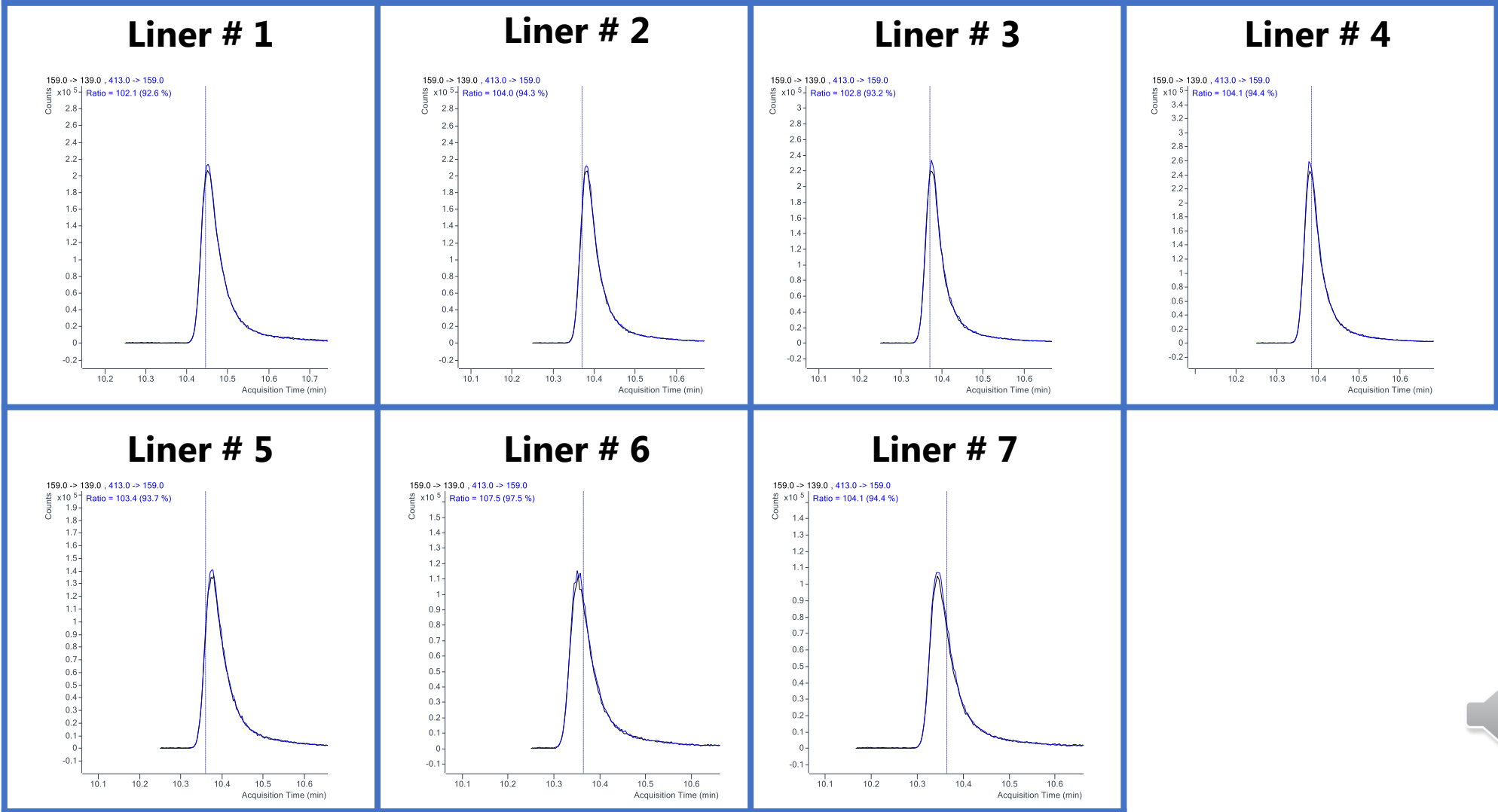
# PEAK SHAPES

**Manual evaluation** of the peak shapes of 188 compounds to spot differences among the liners.

The liner configuration **did not affect** the peak shapes of the compounds, with just one exception.

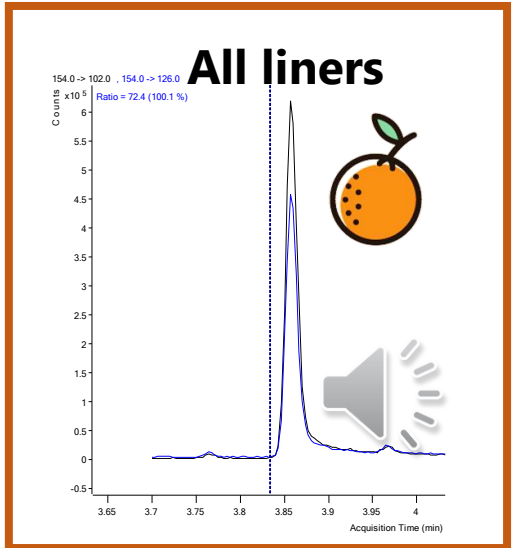
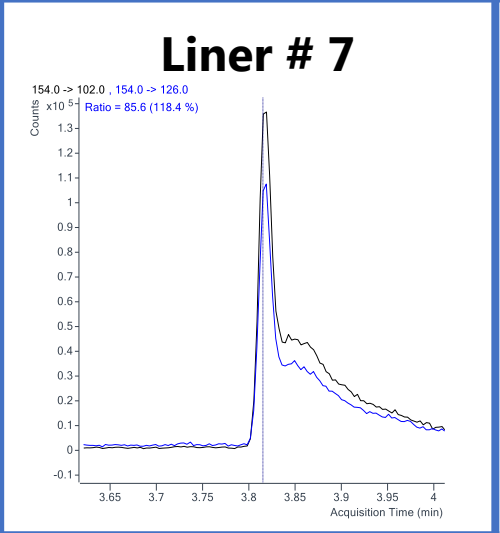
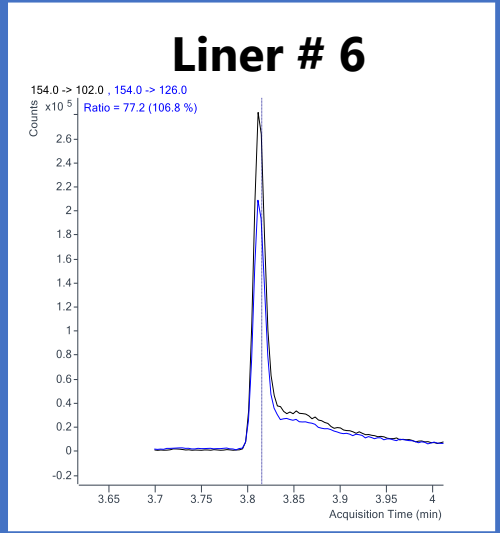
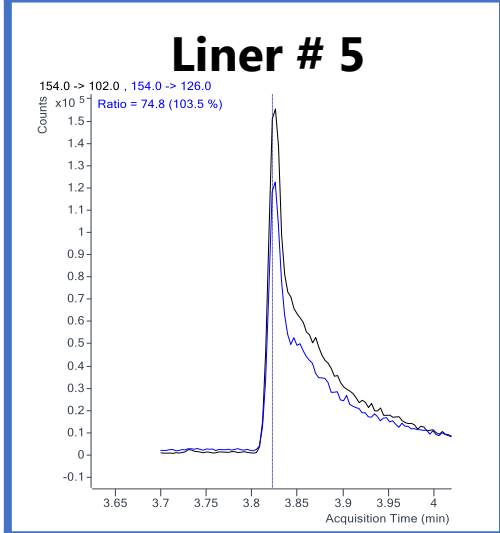
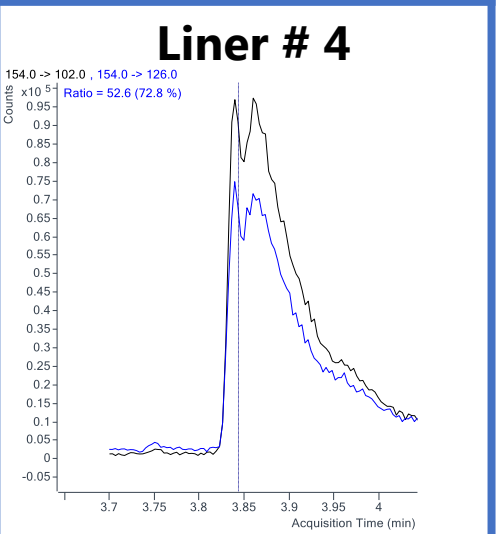
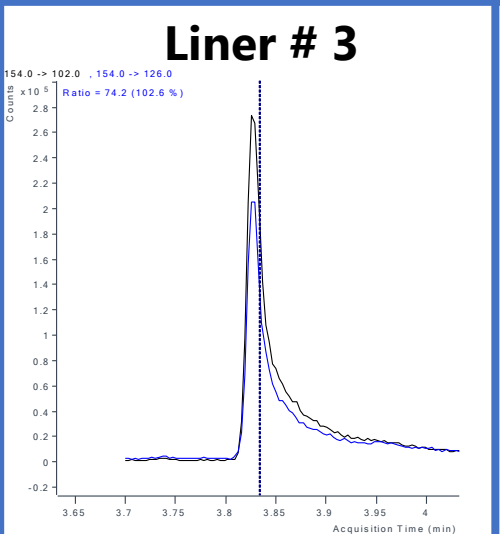
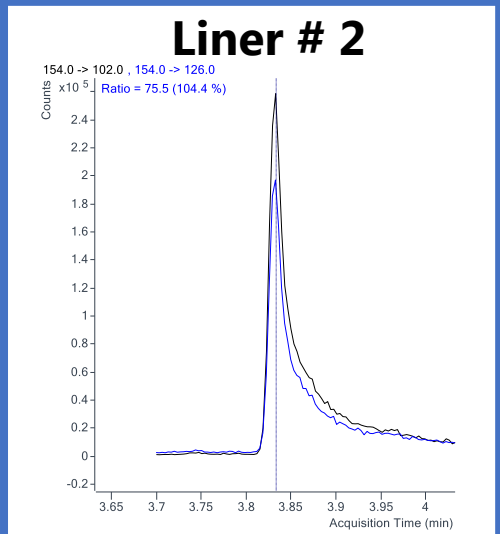
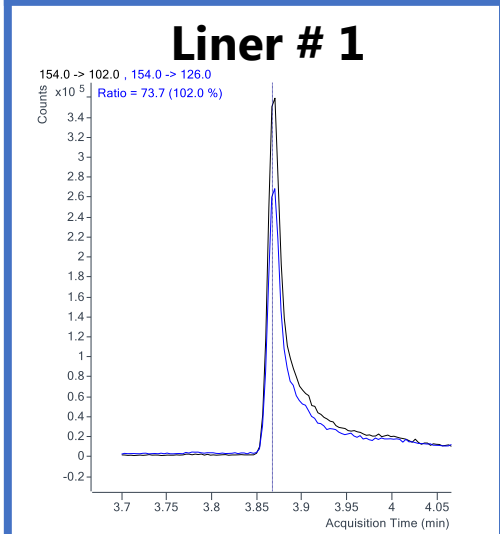


## Bixafen in tomato (50 µg/kg)





## Biphenyl in tomato (50 µg/kg)





# LINERS # 8 AND 9

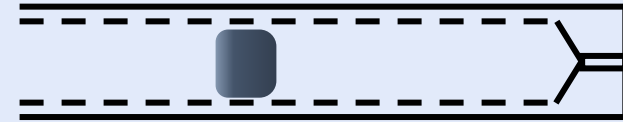
They contained glass frit/wool in **middle position**

Their **maximum capacity** was in both cases higher than the sample volume after evaporation

Suitable for **splitless** injection

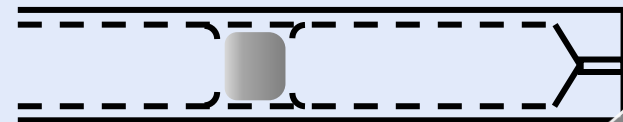


Liner # 8



Glass frit, **medium position**

Liner # 9



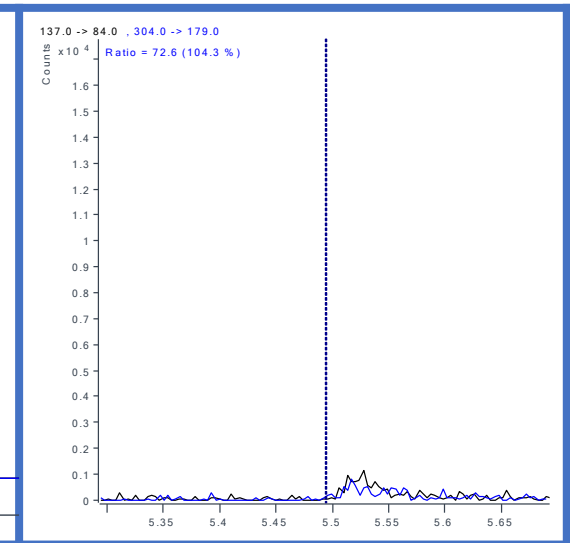
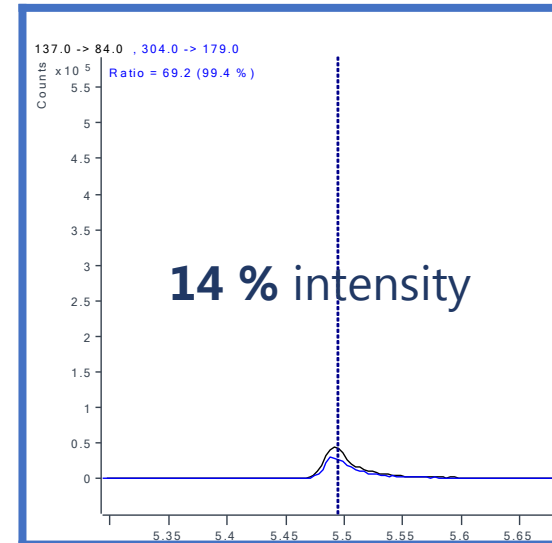
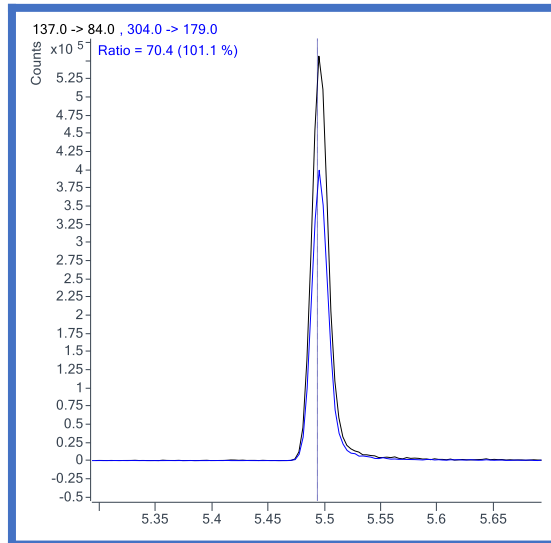
Tapered glass wool, **medium position**

## Liner # 1

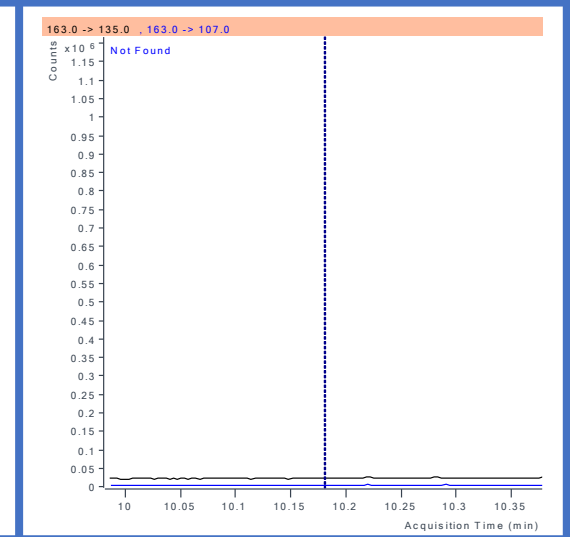
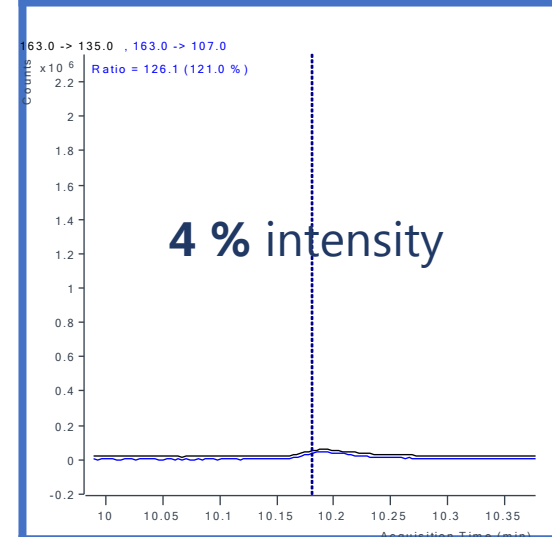
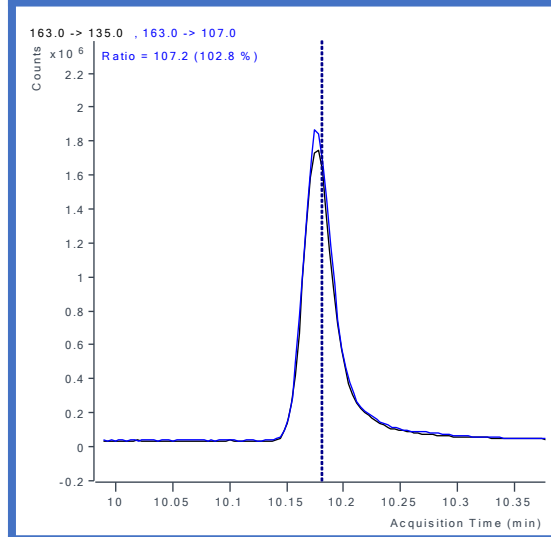
## Liner # 8

## Liner # 9

**Diazinon**



**Etofenprox**

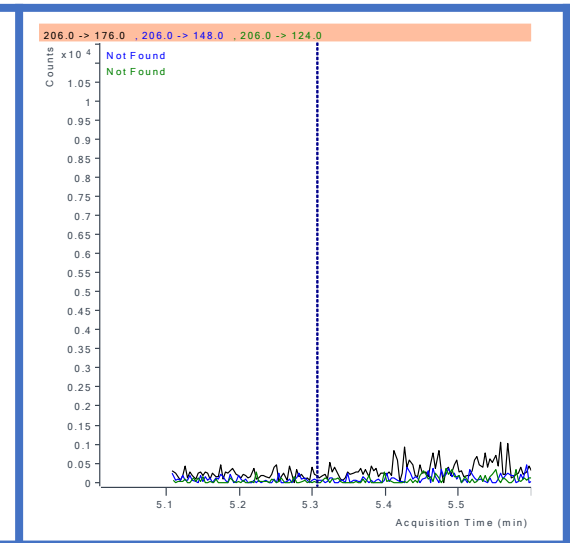
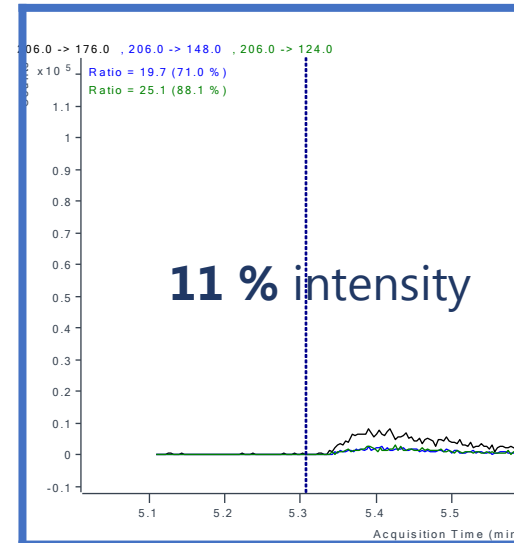
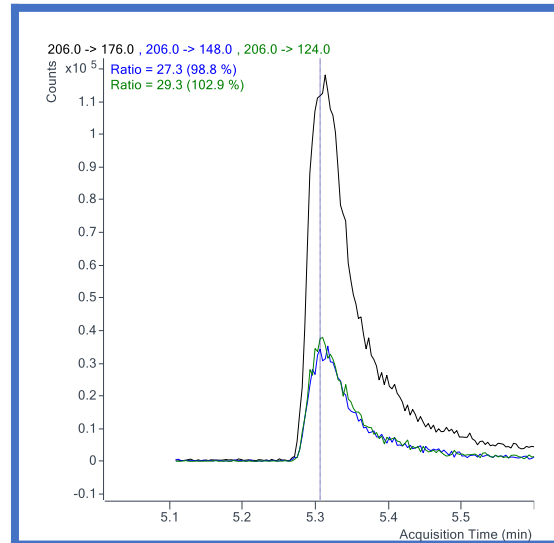


## Liner # 1

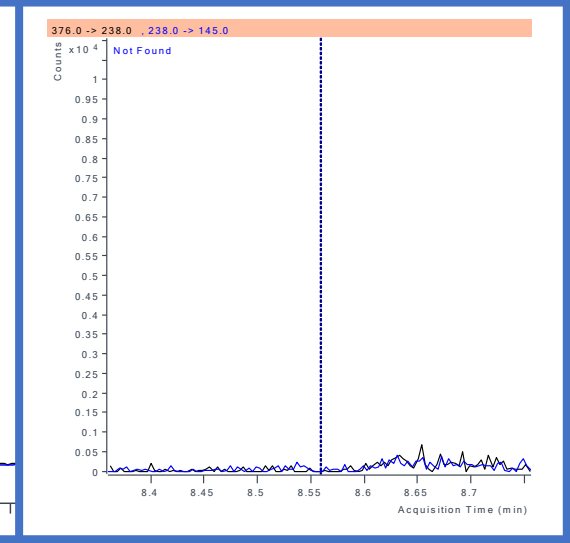
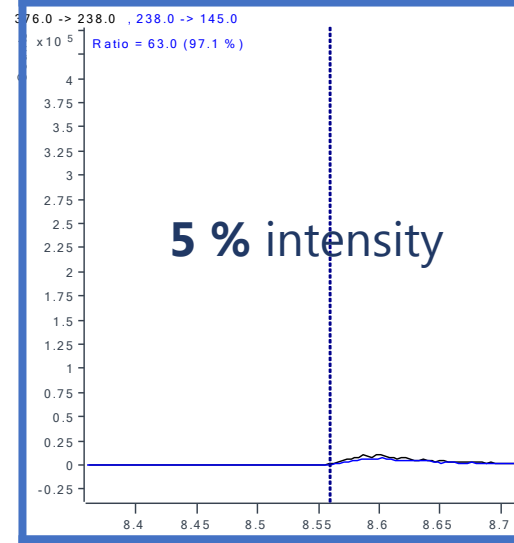
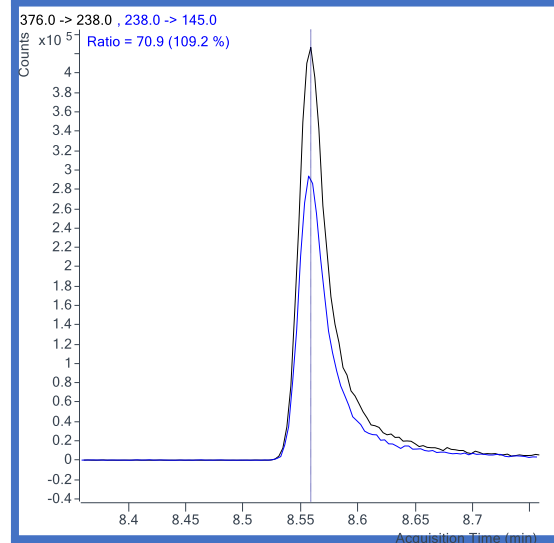
## Liner # 8


## Liner # 9

**Dicloran**



**Picolinafen**



A background image showing a laboratory setting with several small vials in a rack. Some vials contain yellow liquid, while others are empty. The scene is partially obscured by a blue geometric overlay.

**Thank you  
for your attention**



**1. Does a reduced internal diameter affect the sensitivity of compounds?**

- a) No, it doesn't                                      b) Yes, it decreases most signals                                      c) Yes, it increases most signals

**2. The single taper geometry resulted in \_\_\_\_\_ peak shapes for biphenyl in tomato.**

- a) Better                                                                                      b) The same                                                                                      c) Poorer

**3. Did the different deactivation processes in liners 1, 2 and 3 affect their durability?**

- a) Yes, it affected both matrices equally                                      b) Yes, its effected mainly in tomato matrix                                      c) No, there was no effect

