

# Detection of cannabinoids in hair samples using an automated technique

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# Advantages of Hair Analysis

- Longer time frame of detection (weeks, months, years)
- Non-invasive
- Pattern of drug use/abstinence can be established



# Applications of hair testing

- Evidence of drug abuse
- Gestational drug exposure
- Child Protection
- Workplace drug testing
- Therapeutic monitoring
- Driving Licence Renewal
- Long term poisoning
- Doping Control (sports)
- Stress monitoring
- Drug Facilitated Sexual Assault Investigations
- Environmental Monitoring
- Agrioforensics



# Current Analysis Methods

- GC-MS/MS
- LC-MS/MS



- Labour-intensive sample preparation has led researchers to consider other techniques such as MALDI/DESI/DART



# Manual Workflow

- 1) Segmentation (cutting of hair sample)
- 2) Weighing of sample
- 2) Decontamination (washing)
- 3) Digestion
- 4) Extraction
- 5) Derivatisation
- 6) Injection, Separation and MS analysis
- 7) Interpretation of results



# Automated Workflow

1) Segmentation (cutting of hair sample)

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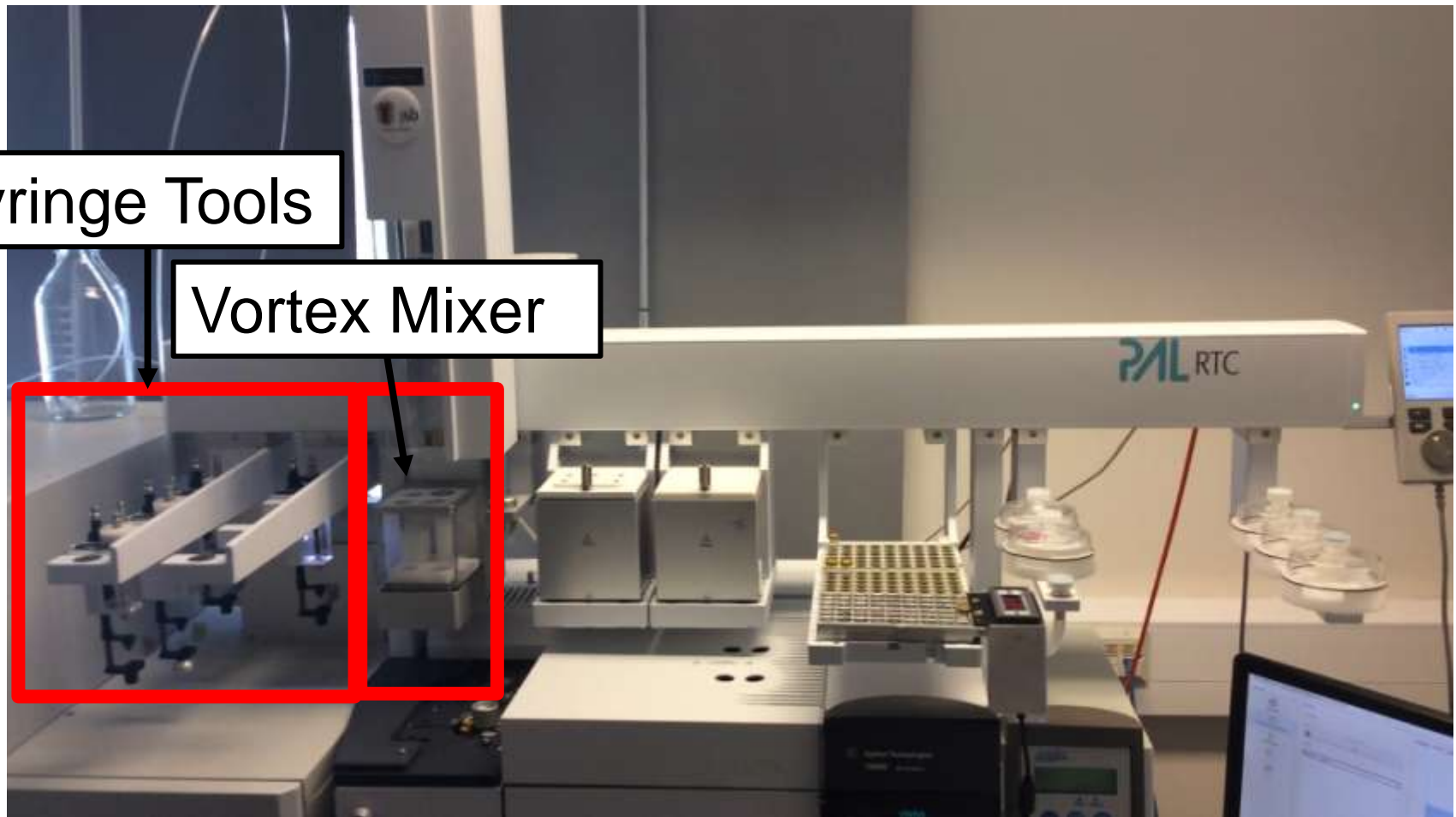
# PAL-RTC Autosampler



Syringe Tools

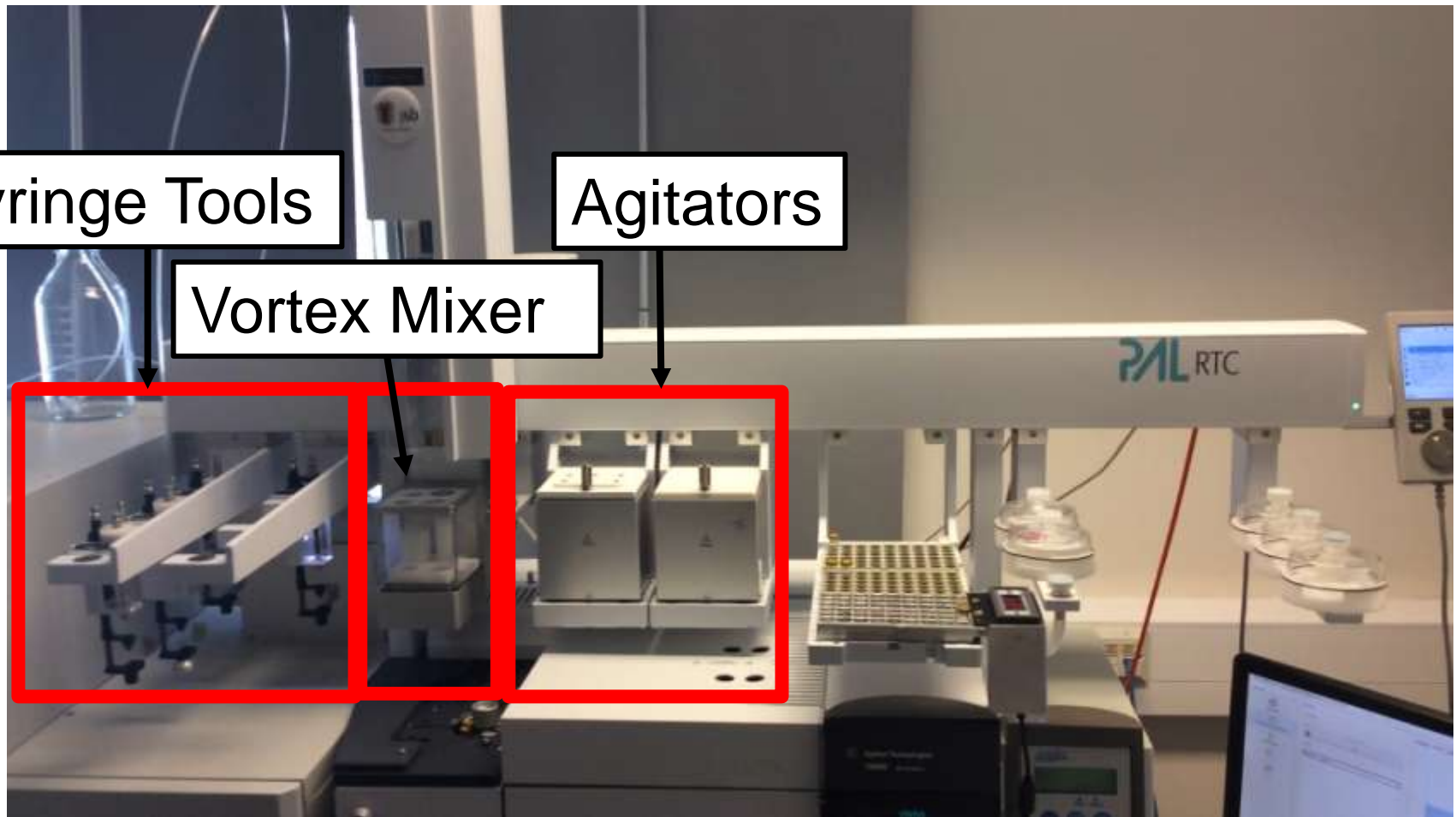


# PAL-RTC Autosampler

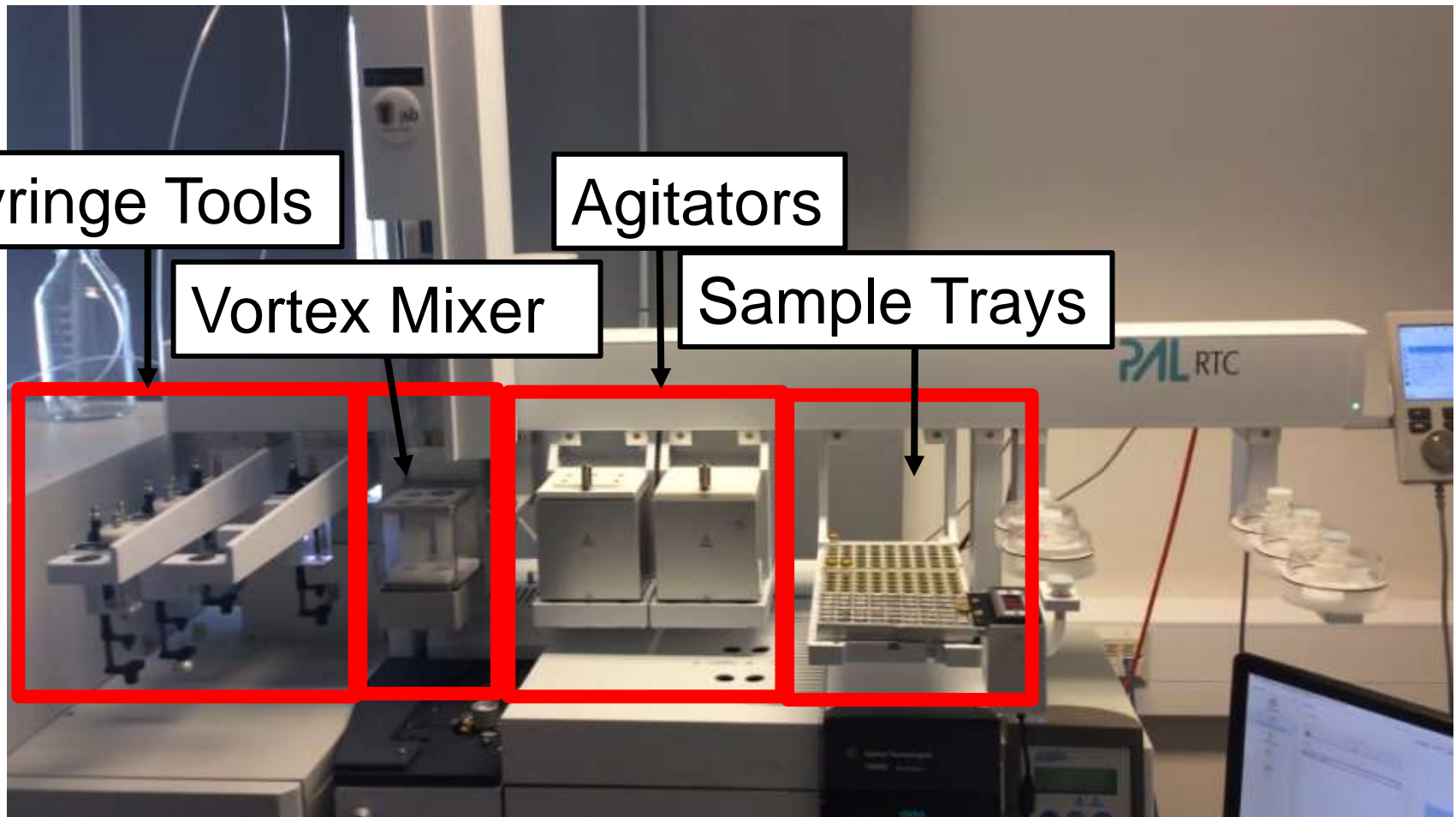




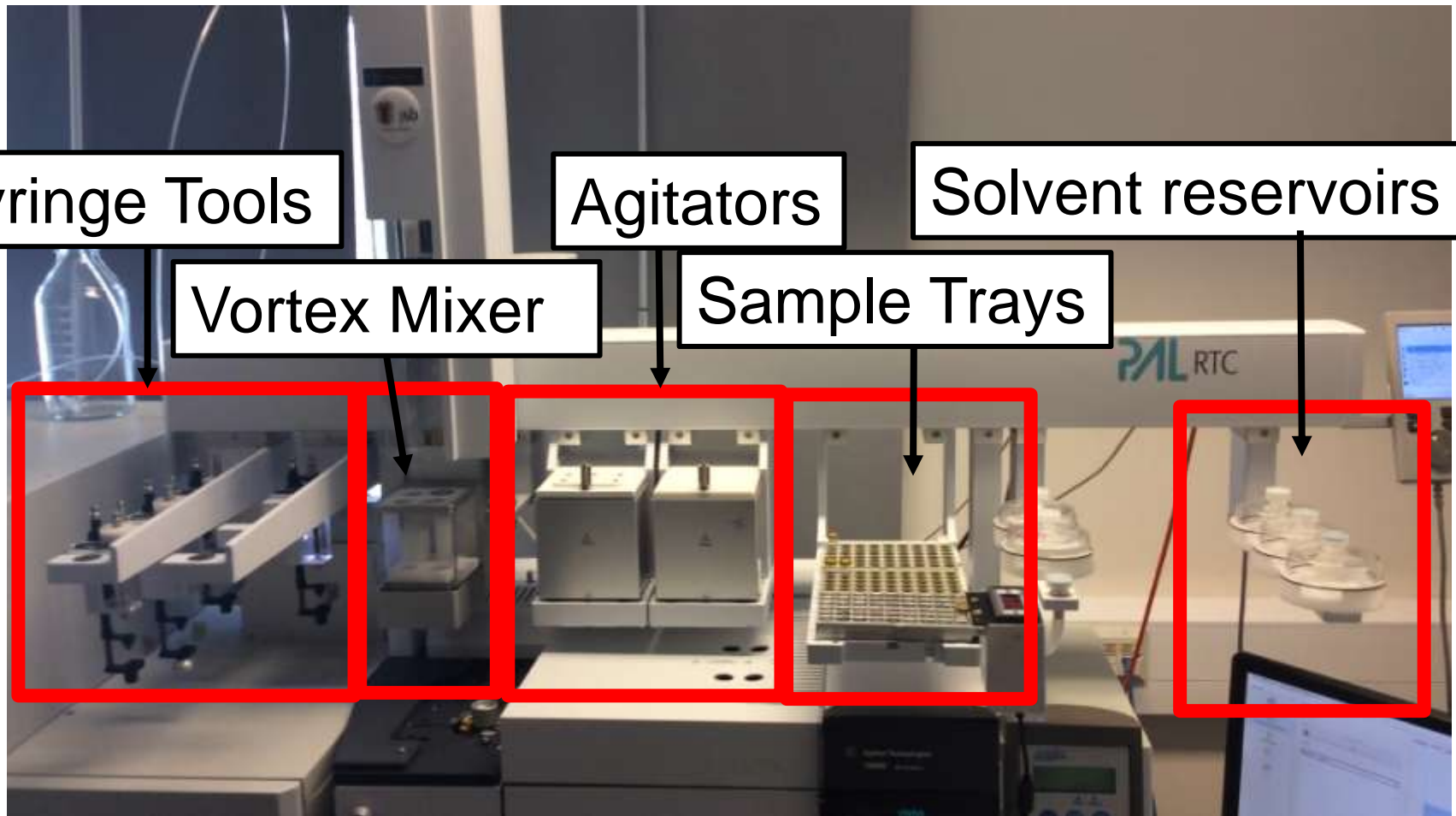
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# PAL-RTC Autosampler



# Automated Workflow

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# Decontamination (washing)

- Necessary to remove external contamination from hair samples
- 2x methanol washes completed with syringe tools
- Sample is vortexed after each addition of methanol
- Washes can go to waste or on to further analysis



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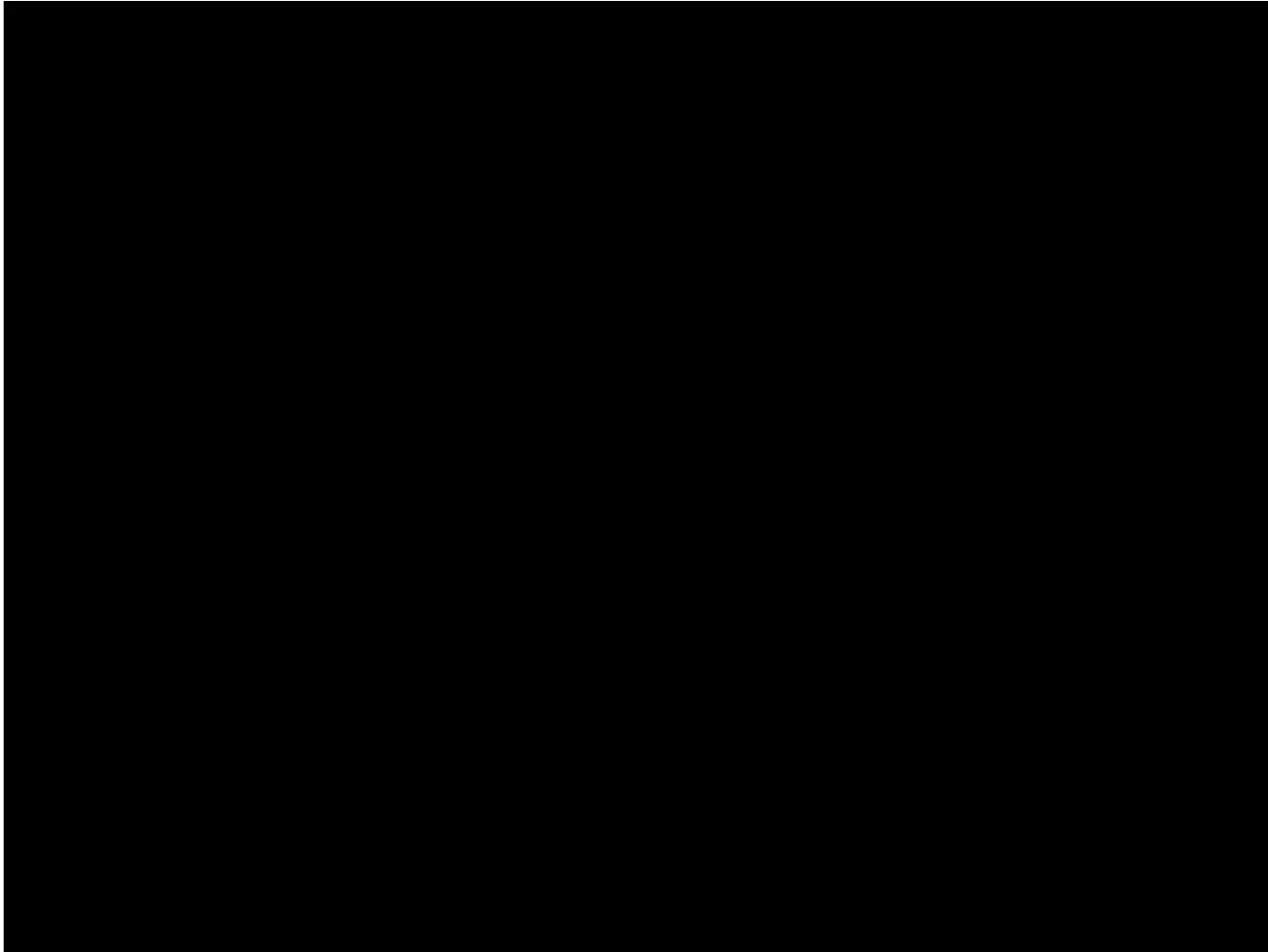


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# Digestion



Before



After



# Automated Workflow

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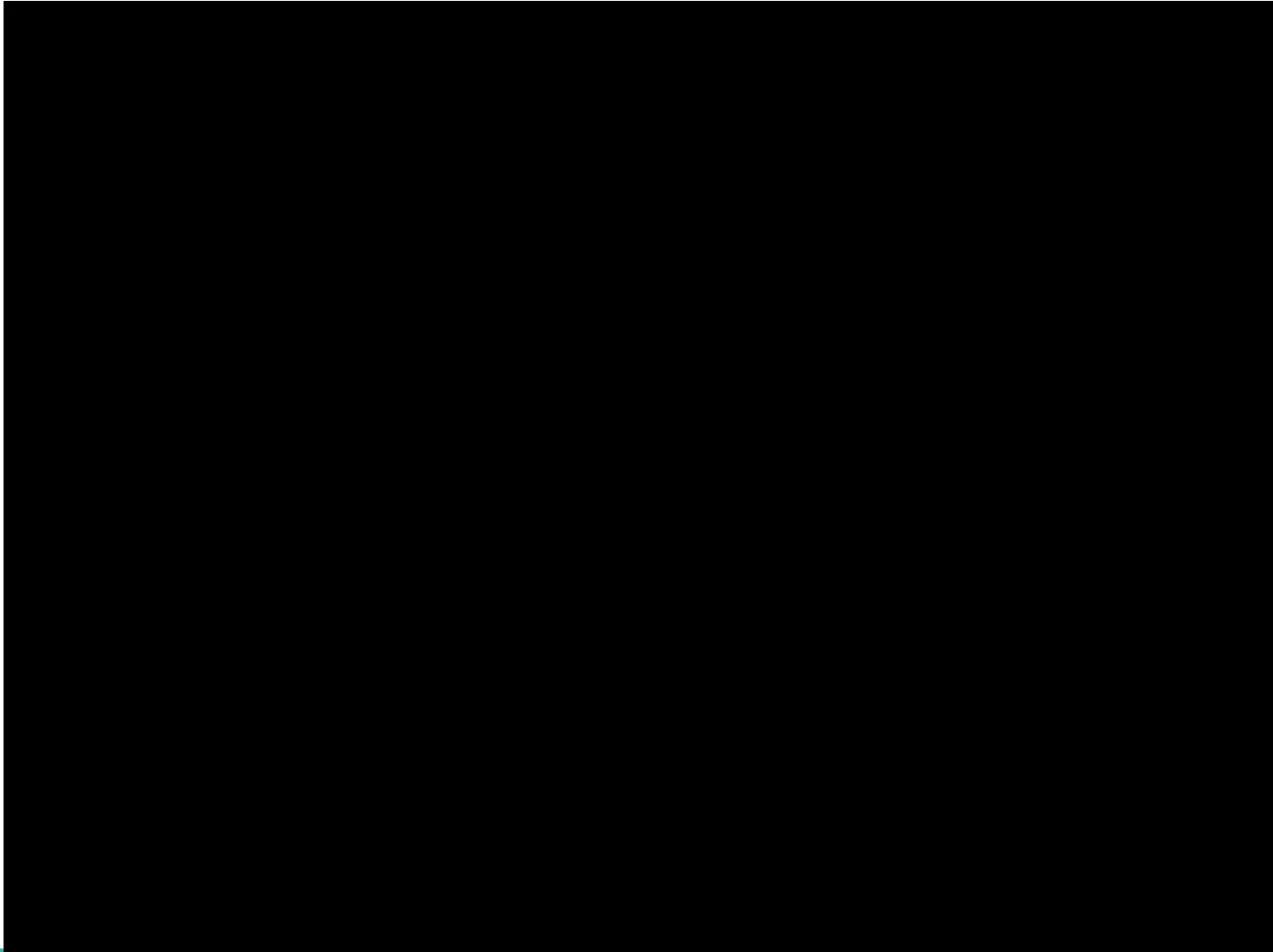


# Extraction

- Liquid-liquid extraction
- Bottom layer  
(inorganic waste)
- Top Layer (organic layer)  
containing analytes of  
interest
- Ability to set needle depth  
within sample



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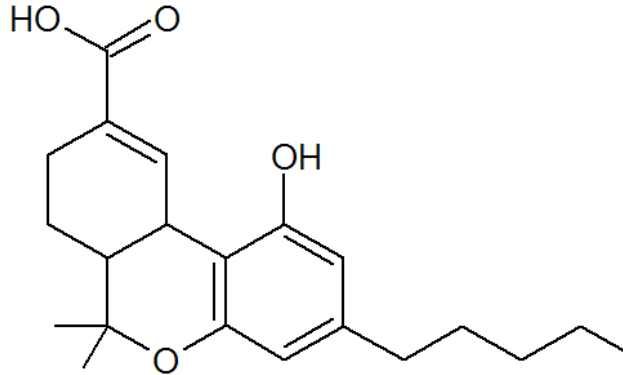


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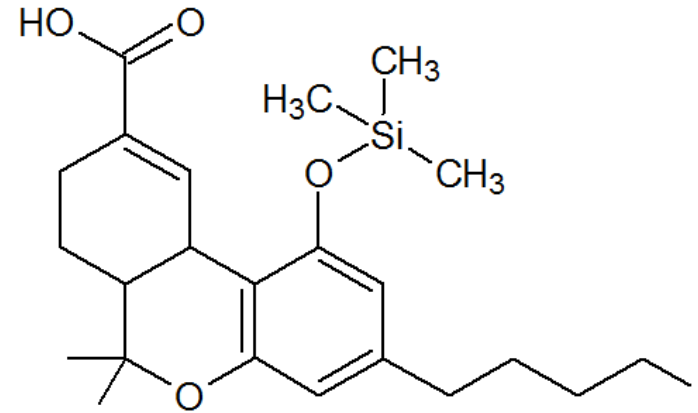
# Derivatisation



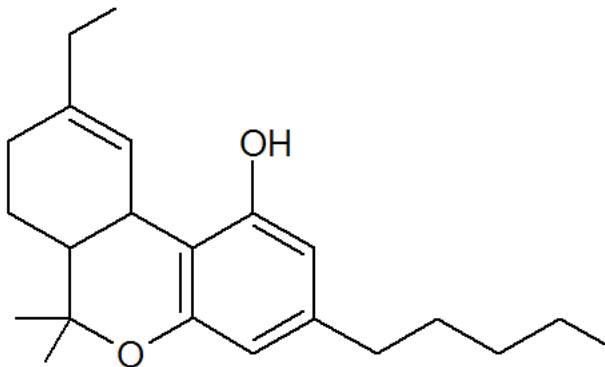
THC-COOH



Heat



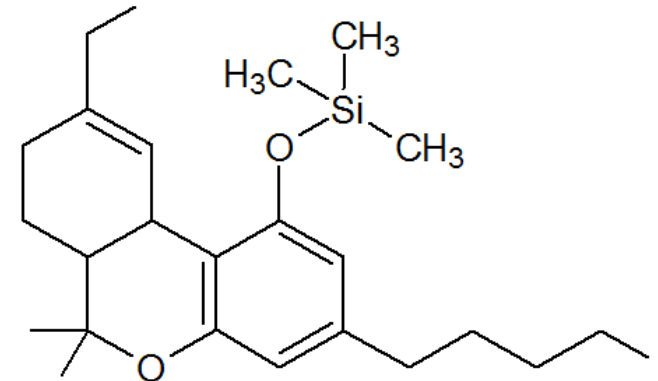
TMS derivative



11-OH-THC



Heat



TMS derivative



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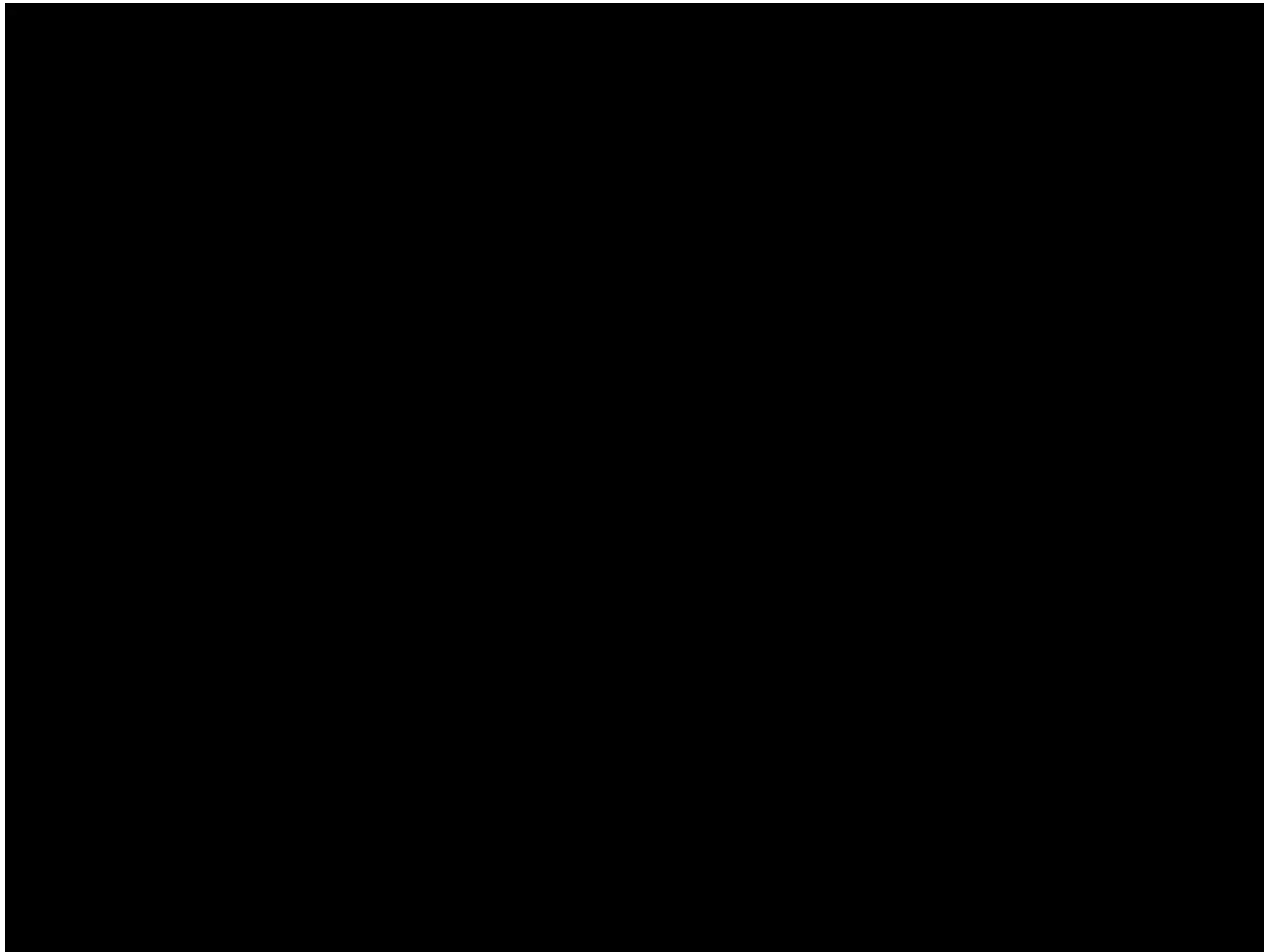


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# Injection, Separation and MS analysis



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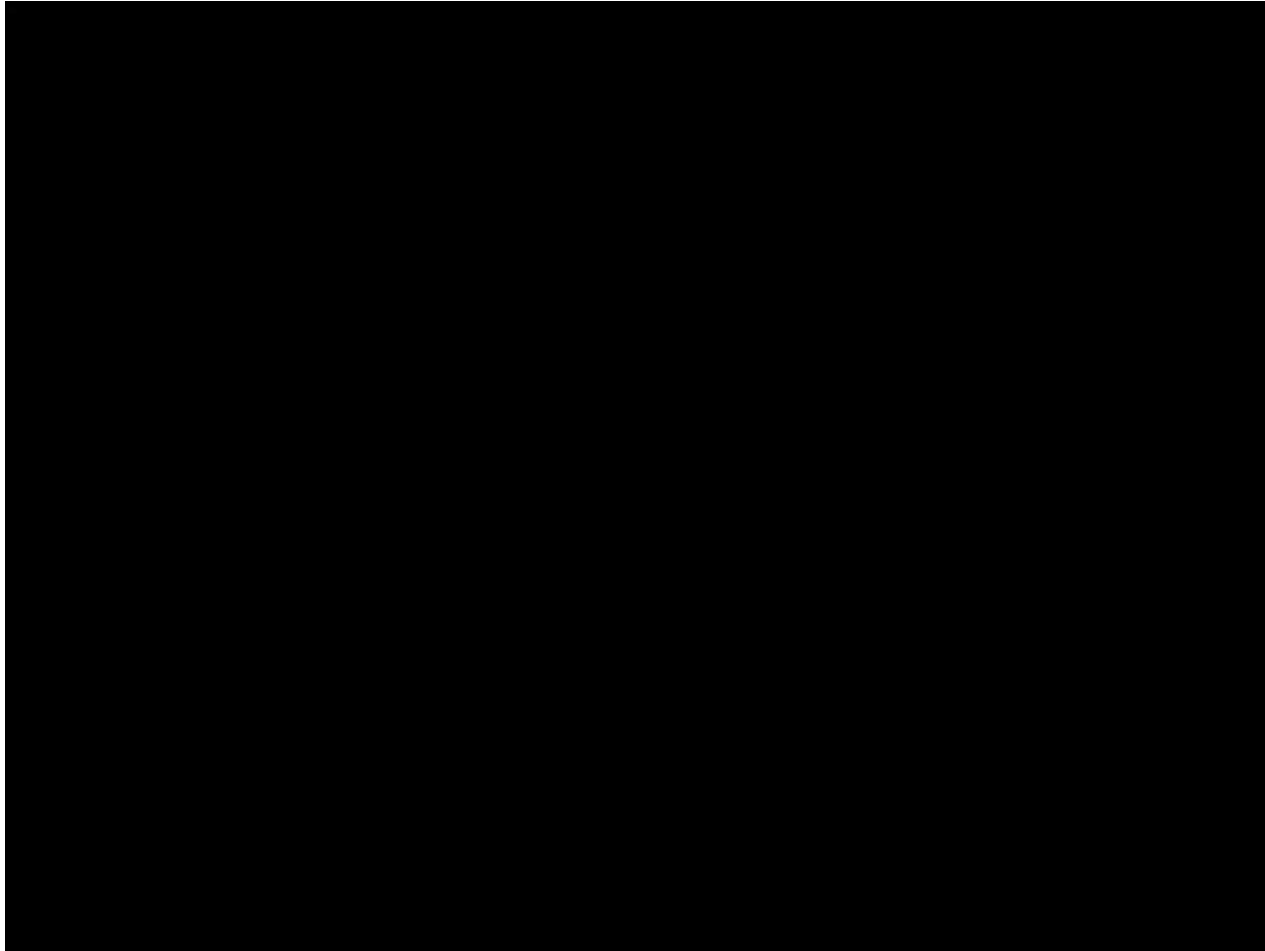
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# Automated Serial Dilution



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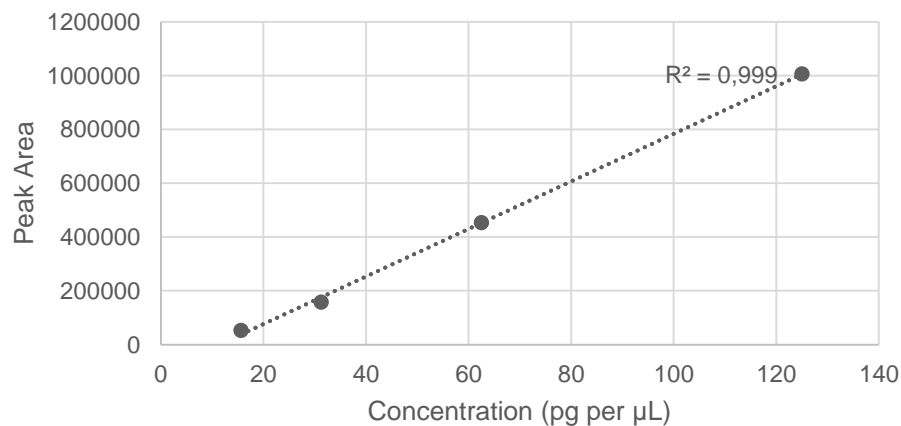
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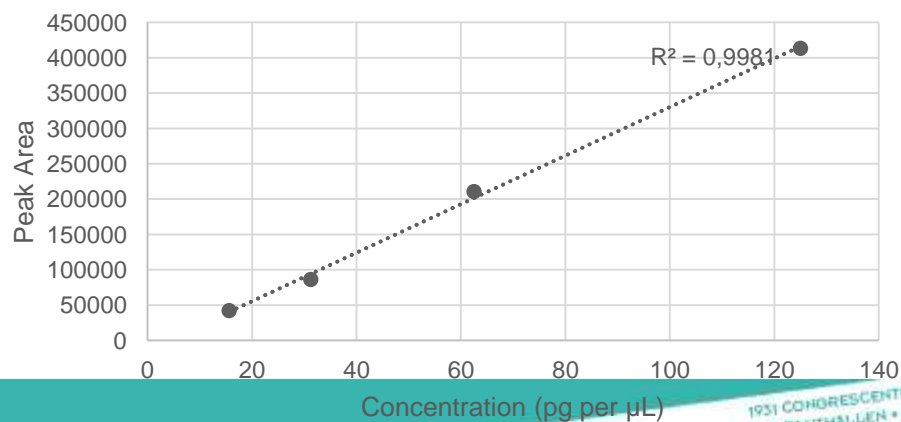


# Automated Serial Dilution

11-Hydroxy- $\Delta^9$ -tetrahydrocannabinol  
(11-OH-THC)



11-Nor-9-carboxy-THC  
(THC-COOH)



# Summary

## Full Automation of:

- Preparation of calibrants
- Washing
- Digestion
- LLE Extraction
- Derivatisation
- Injection into GC-MS System



# Acknowledgements:

- **Sheffield Hallam University:** Biomedical Research Centre  
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- JSB

**Andrew Ward**



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