Overview of Vacuum UltraViolet Absorption Detection for Gas Chromatography

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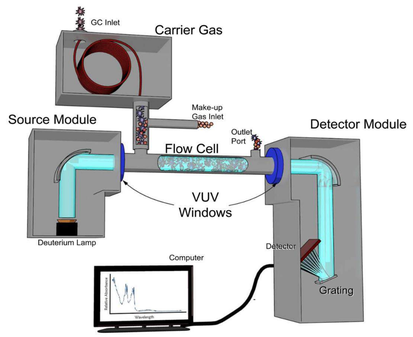
OVERVIEW/INTRODUCTION

- **Gas chromatography coupled with vacuum ultraviolet spectroscopy (GC-VUV) Is a powerful tool for detecting and analyzing cannabinoids and their metabolites.**
- **GC-VUV offers enhanced differentiation of structurally similar compounds.**
- **Provides advantages over traditional methods like GC-MS and LC-MS.**
- **Highlights research from Leghissa et al. (2018), Skultety et al. (2017), and others.**
- **Focuses on GC-VUV's applications in forensic and pharmaceutical sciences.**

METHODS



Sample Preparation:

- Cannabinoids & Synthetic Drugs: Derivatization with BSTFA + 1% TMCS for enhanced volatility
- Biological Samples: Liquid-liquid extraction with ethyl acetate, followed by centrifugation, filtration, and derivatization

Instrumentation:

- **Agilent 7890 GC system with VGA-100 VUV detector**
- **DB-5MS column** (30 m x 0.25 mm x 0.25 µm)
- **Injector**: 280°C, split ratio 10:1, 1 µL injection

Analytical Conditions:

- **GC Oven**: 100°C (initial), ramped to 280°C (final)
- **Carrier gas**: Helium (1.2 mL/min)
- **VUV Detector**: 120-240 nm, 0.5-second spectral data collection

Previous Studies: Skeltety et al. (2017) used:

- **GC Column**: RTX-1, 30 m, 0.25 mm i.d., 0.25 µm df
- **Autoinjector**: Shimadzu AOC-20i, 1.0 mL sample, 100 mg/mL standard concentrations
- **Injector**: 250°C, splitless mode
- **VUV Transfer Line/Flow Cell**: 300°C, 10 cm path, 80 mL volume
- **VUV Lamp**: Deuterium, Data Rate: 1.3 Hz
- **Carrier Gas**: Helium, constant velocity 28 cm/s
- **Oven Program**: 50°C to 300°C, various ramp rates
- **LOD**: Determined by S/N ratio (3:1)

RESULTS

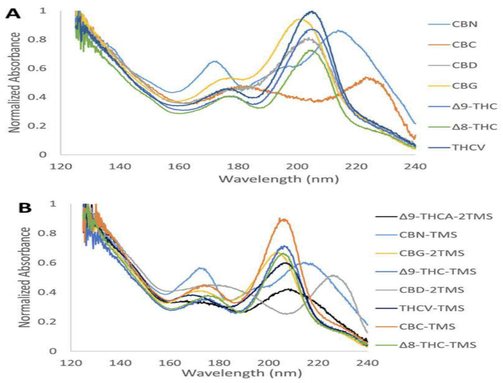


Figure 1: Normalized gas phase VUV/UV absorbance spectra for (A) underivatized and (B) silylated cannabinoids.

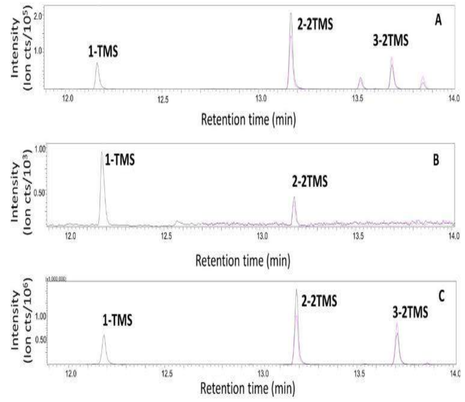


Figure 2: Representative MRM chromatograms for: (A) a 4 ppm mixture extracted from urine matrix; (B) 0.6 ppm mixture extracted from a plasma matrix; and (C) a mixture of standards at 15 ppm. Analytes correspond to the indicated silylated forms of: 1 Δ9-THC; 2 Δ9-THC-OH; and 3 11-nor-9-carboxy-Δ9-THC

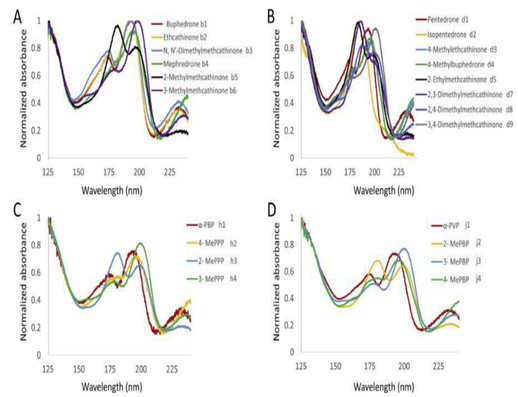


Figure 3: VUV reference spectra of selected isomeric NDS sets: (A) b1-b6, 177.1154 g/mol; (B) d1-d9, except of d6, 191.1310 g/mol; (C) h1-h4, 217.1467 g/mol; (D) j1-j4, 231.1623 g/mol.

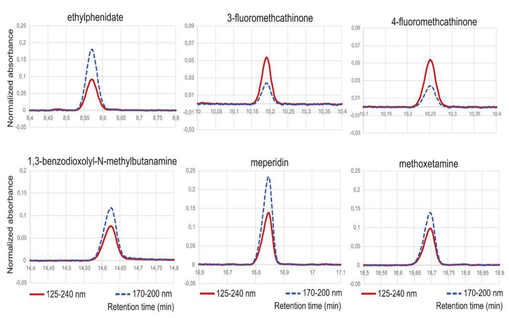
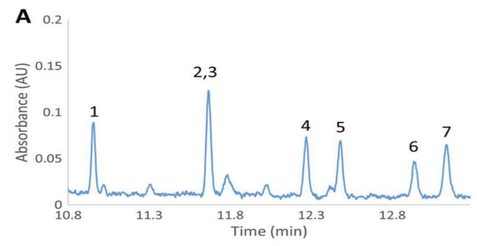


Figure 4: Normalized absorbance plotted against retention time for six NDS and two wavelength windows [125-240 nm (full range) and 170-200 nm (preferential for aromatics)] in GC-VUV analysis of standards.

Legend:
1 – THCV (Tetrahydrocannabivarin)
2 – CBD (Cannabidiol)
3 – CBC (Cannabichromene)
4 – Δ8-THC (Delta-8-Tetrahydrocannabinol)
5 – Δ9-THC (Delta-9-Tetrahydrocannabinol)
6 – CBG (Cannabigerol)
7 – CBN (Cannabinol)



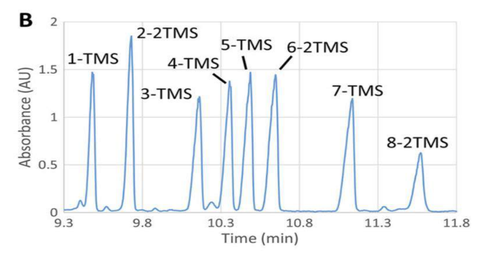


Figure 5: Representative chromatograms of (A) underivatized and (B) silylated cannabinoids. Shown are signals filtered for response in the 125-160 nm wavelength range.

CONCLUSIONS

GC-VUV Analysis:

- **Provides a powerful approach for analyzing cannabinoids and synthetic drugs**
- **Allows clear differentiation of structurally similar compounds without full chromatographic separation**

Comparison to GC-QQQ-MS:

- **GC-VUV simplifies data analysis**
- **May require sensitivity improvements for biological matrices**

Future Research Directions:

- **Focus on optimizing sensitivity for better analysis**
- **Expand applications to forensic toxicology, petroleum analysis, and pharmaceutical impurity detection**

REFERENCES

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ACKNOWLEDGEMENTS

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