Trifluoroacetyl Derivatization of Amphetamine, Methamphetamine, MDMA and Other Controlled Substances with Similar Mass Spectra

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Abstract

For the identification of a controlled substance, mass spectrometry is the most commonly used method. However, there are some cases where the controlled substance shares a similar mass spectrum with a drug of a lower scheduling or a compound that is not even considered to be a controlled substance, such as methamphetamine and phentermine. Here, it is proposed that the derivatization of these compounds will create mass spectra that are sufficiently different enough to make a positive identification. Controlled substance standards were derivatized with trifluoroacetic anhydride and analyzed with a GC-MS, resulting in unique, identifiable spectra for each standard.

Introduction

- Amphetamine and other amphetamine-related designer drugs share similar mass spectra
- Scientific Working Group for the Analysis of Seized Drugs (SWGDrug) recommends at least one other separate form of analysis be used to identify a controlled substance
- Small or publicly funded labs might not have sufficient funds to obtain the instrumentation to conduct a second analytical procedure
- Some designer drugs have similar gas chromatographic retention times
- Derivatization of the drugs could lead to improved GC properties and formation of unique and discriminating mass spectral fragment ions
- Derivatization provides a second category A test according to SWGDrug guidelines
- Trifluoroacetic anhydride (TFAA) used to replace the active hydrogen on the primary and secondary amines of the amphetamine and amphetamine-related designer drugs with a perfluoroacyl group
- Supplemental experiment was conducted, mixing several controlled substances commonly found combined with each other in street drugs

Controlled Substances

- Amphetamine
- Methamphetamine
- MDMA
- MDEA
- MDA
- DOC
- DOB
- DOM
- DOI
- Ketamine
- Phentermine
- Fenfluramine

Instrumentation

- Hewlett Packard GC-MS 6890
  - 20 m column, (5%-phenyl)-methylpolysiloxane stationary phase, 0.18 mm diameter, 0.18 µm film thickness
  - Helium carrier gas, flow rate 1.0 mL/min, split ratio 80:1
  - 250 C at injector port
  - Initial temperature 100 C, hold 2 minutes
  - Ramp up to 175 C at rate of 10 C/min
  - Second temperature ramp to 300 C at rate of 25 C/min, hold until end of 15 minute run time

Methods

Standard Solutions

- Dissolve 2 mg drug standard in 1.5 mL chloroform
- Add a drop of base
- Analyze with GC-MS

Derivatized Solutions

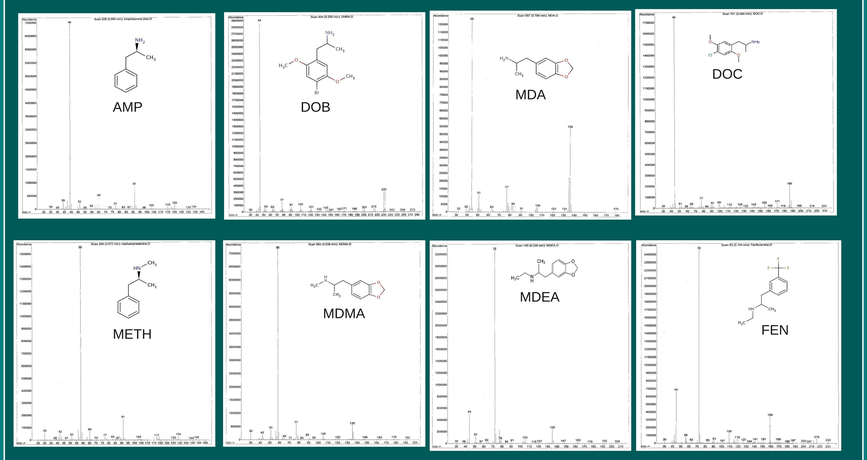
- Dissolve 2 mg drug standard in 1.5 mL chloroform
- Add 200 µL TFAA and 100 µL pyridine
- Let react for 15 minutes at room temperature
- Add equal volume NaOH, vortex, let separate
- Transfer chloroform layer to GC vial
- Analyze with GC-MS

Mixed Solution

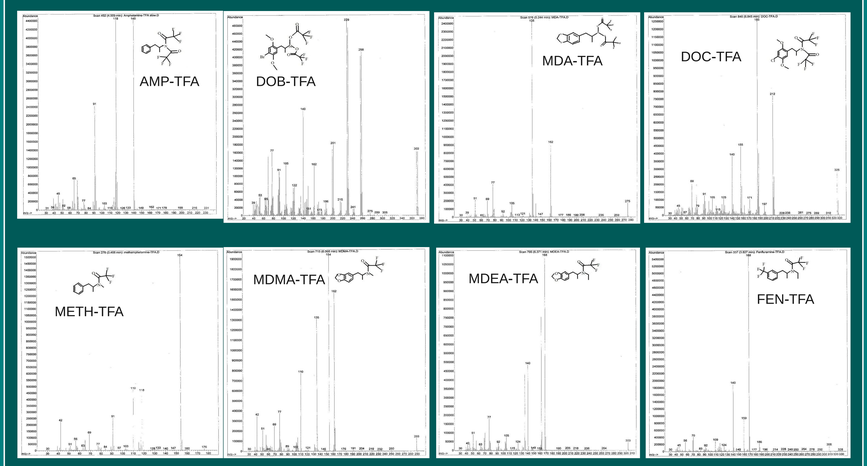
- Dissolve 1 mg of each of following drug standards in 1.5 mL chloroform
  - Amphetamine, methamphetamine, MDA, MDEA, ketamine
- Add 500 µL TFAA and 200 µL pyridine
- Let react for 15 minutes at room temperature
- Add equal volume NaOH, vortex, let separate
- Transfer chloroform layer to GC vial
- Analyze with GC-MS

Results

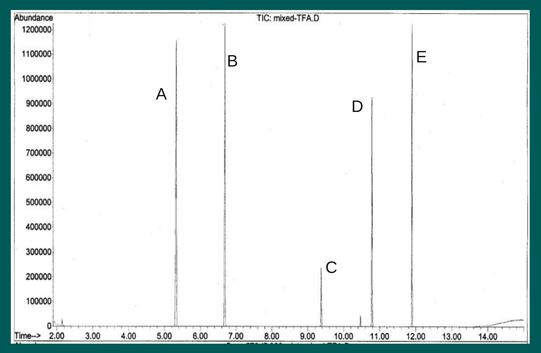
Without Derivatization



TFA Derivatives



GC-MS of Mixed Solution



Key	Drug	Ion(s) - m/z *	RT - min
A	Amp-TFA	118, 140, 91	5.32
B	Meth-TFA	154, 118, 110	6.67
C	MDA-TFA	135, 162	9.37
D	MDEA-TFA	168, 162, 140, 135	10.77
E	Ketamine-TFA	110, 125, 152, 270	11.89

** Qualifier ions; quant. ions underlined*

Conclusions

This study showed that derivatization is a viable method to produce a unique, identifiable mass spectra for a controlled substance, that the derivatization process can be conducted at room temperature, and that the same technique can be applied to a drug mixture. Future studies will be conducted looking at different derivatizing agents, controlled substances, and chromatographic conditions. Quantifying as well as qualifying controlled substances via derivatization will also be researched.

Acknowledgements

The materials and facilities for this research were provided by the Austin Police Department. A special thanks is given to Dr. Pamela Staton of Marshall University for providing the initial contact with APD.

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