Hidden Traces: An Alternative Analytical Scheme for Seized Drug Analysis

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ABSTRACT

The traditional seized drug analysis process involves quick and cost-effective presumptive testing, followed by more discriminatory analysis. Before the seized drug evidence is analyzed, the evidence must be weighed, with the weighing matrix typically being discarded as chemical waste. However, the drug residue transferred during the weighing process creates an opportunity for a rapid and reliable screening technique using direct analysis in real time-mass spectrometry (DART-MS). This study provides a novel DART-MS screening method for seized drug evidence using filter paper and glassine paper weighing matrices commonly found in forensic laboratories.

INTRODUCTION

The traditional seized drug analysis process involves weighing an evidence submission before sampling and analysis. Typically, presumptive testing is employed to influence decisions regarding more specific, discriminatory testing [1]. Whereas color tests are frequently employed due to their quick and cost-effective nature, limitations include the use of harsh chemicals, subjective determinations, obtaining only drug-class-specific information, and poor responses for novel psychoactive substances (NPS) [2]. With the rise in NPS and growing backlogs in forensic laboratories, the development of a more rapid and discriminatory screening technique has become crucial for the seized drug community.

In this study, a novel screening method for seized drug analysis was developed using DART-MS and weigh paper to detect trace residues of seized drug material deposited during the weighing process. Validation experiments were performed using glass capillaries, filter paper, and glassine paper to demonstrate the effectiveness of these alternative matrices compared to a traditional sample matrix. Forty authentic samples, 20 filter papers and 20 glassine papers, were analyzed and the resulting spectra were searched using the NIST DART-MS Forensics Database and Data Interpretation Tool (DIT). The results were then compared against ground truth GC-MS data to determine the efficacy of the method.

MATERIALS & METHODS

Chemicals and materials

Sixteen controlled substances, adulterants, and diluents were analyzed in this study. The controlled substances included phencyclidine, heroin, fentanyl, methylphenidate, phentermine, cocaine, methamphetamine, amphetamine, alprazolam, lorazepam, and diazepam. The adulterants and diluents were caffeine, aspirin, acetaminophen, phentermine, pseudoephedrine, and nicotine. Tetracaine was used as an internal standard. Three sampling matrices were used in this study: glass capillaries, Whatman 3 filter papers, and VWR® weighing (glassine) papers. Authentic samples were provided by the Houston Forensic Science Center (HFSC).

RESULTS & DISCUSSION

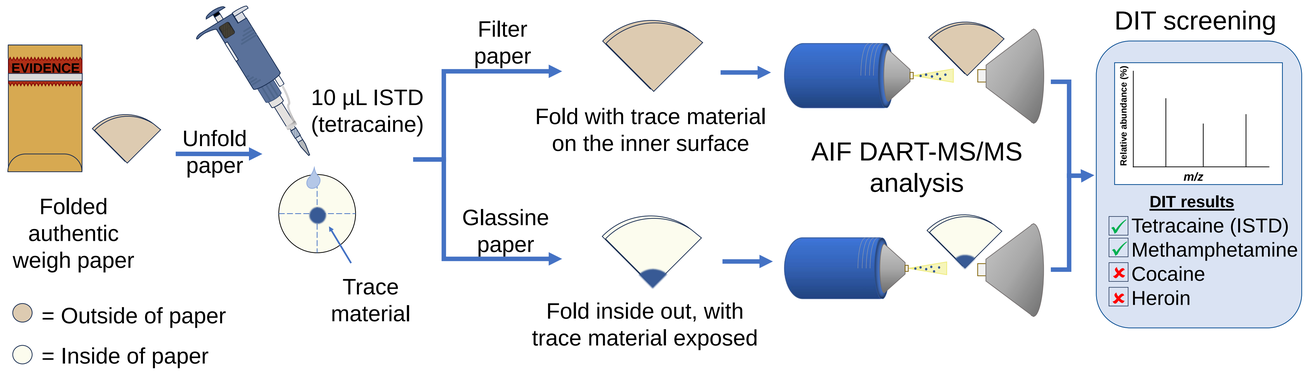

Figure 1. Overview of the novel seized drug screening method utilizing DART-MS and used weigh paper.

❖When using filter paper, the internal standard is allowed to wick through, and the outside of the paper is introduced into the DART source.

❖When using glassine paper, the sample is folded inside out with the trace material exposed and inserted into the DART source.

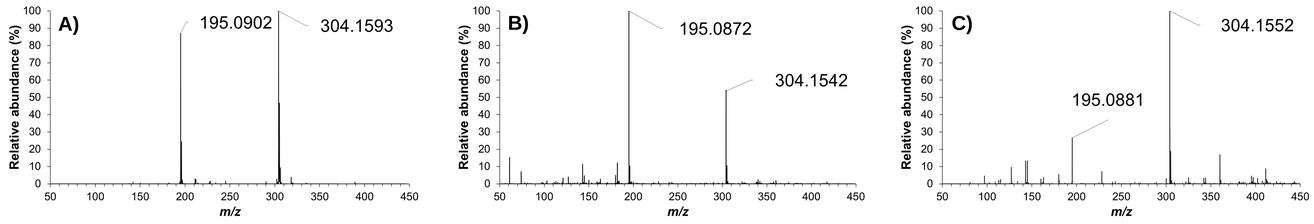

Figure 2. Comparison of a 50:50 cocaine:caffeine mixture using the three matrices: A) glass capillary, B) filter paper, and C) glassine paper.

❖Although there are differences in the base peak, both components are identifiable with the NIST DART-MS Forensics Database and DIT.

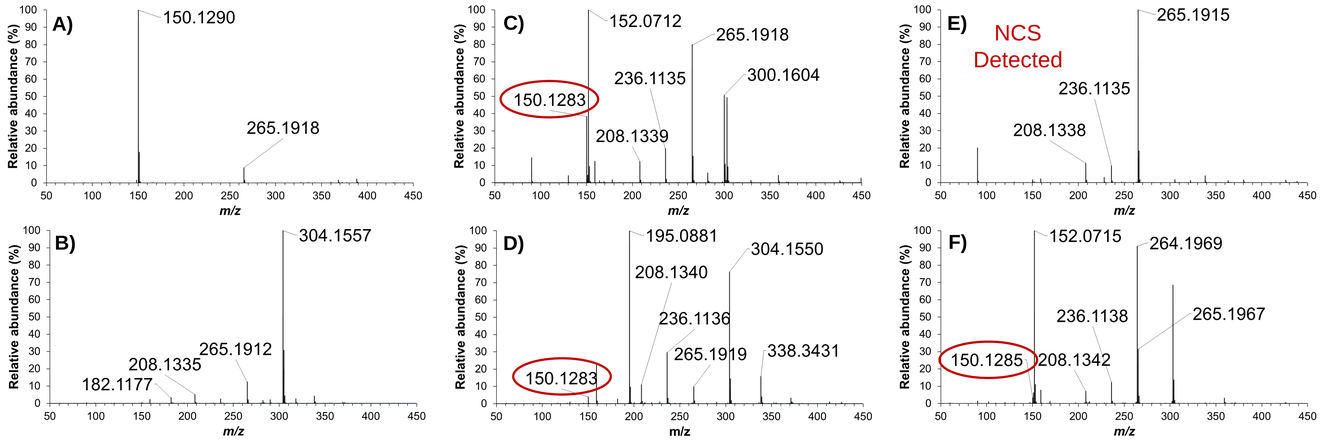

Figure 3. Exemplar low energy spectra for filter paper and weigh paper demonstrating successful results for A) Unknown FP #4 and B) Unknown GP #10, methamphetamine contamination in C) Unknown FP #8 and D) Unknown GP #6, and typical results when analyzing weigh paper from tablets in E) Unknown FP #2 and F) Unknown GP #20.

❖Compound residues can be detected when analyzing filter paper and glassine paper used for weighing evidence samples.

❖Methamphetamine contamination was observed (5/40 samples), likely derived from analytical balance contamination.

❖The four misidentifications in this study were from samples used to weigh tablets, likely due to decreased sample transfer.

MATERIALS & METHODS

Sample Preparation

Pure and 2-, 3-, and 4-component mixtures were analyzed in this study with a total concentration of 50 ppm in methanol. Samples were prepared by pipetting 5 µL of sample onto glass capillaries and 10 µL of sample onto the filter paper and glassine paper samples.

Validation experiments

The validation studies included matrix effects and limit of detection for all compounds, and selectivity, accuracy, repeatability, reproducibility, and robustness using select representative compounds. Validation studies were completed for all sampling matrices.

Instrumentation and Data Analysis

A DART JumpShot® ionization source was coupled with an Agilent Technologies 6530 Q-TOF mass spectrometer to rapidly analyze all samples. All ion fragmentation (AIF) was used to obtain low (i.e., 0 eV) and high (i.e., 30 eV) activation energy spectra. The resulting data was extracted through MassHunter Qualitative Analysis version 10.0 and exported to Microsoft Excel. Centroid data was searched using the NIST DART-MS Forensics Database and DIT using the Hornet library to screen for the presence of controlled substances.

CONCLUSIONS

- ❖ Development of an alternative seized drug screening method utilizing DART-MS and used weigh paper.
- ❖ Similar performance was observed for all three matrices.
- ❖ The developed method identified the correct controlled substance in 90% (i.e., 36/40) of the authentic weigh paper samples.
- ❖ Methamphetamine contamination was detected in five of the authentic samples; however, this did not prevent the correct identification of the controlled substance present.
- ❖ To increase the likelihood of correct compound identification, tablets should be crushed before the weighing process.

REFERENCES

[1] *Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Recommendations* 2019.

[2] Philp, M. and Fu, S. A review of chemical 'spot' tests: A presumptive illicit drug identification technique. *Drug Test Anal.*, 2018. 10(1): 95-10.

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