B194 An Analysis of Emerging Benzodiazepines by Thermal Desorption/Direct Analysis in Real Time-Mass Spectrometry (TD/DART®-MS)

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Learning Overview: After attending this presentation, attendees will better understand the capabilities of TD/DART®-MS to detect and identify benzodiazepines in pure form as well as in binary mixtures, complex matrices, and real case samples. Attendees will also gain an understanding of the capabilities and weaknesses of this technology and sampling strategies for presumptive screening.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing an optimized method for the use of an emerging technology, TD/DART®-MS, for the detection and analysis of the rising number of benzodiazepine analogs.

Novel Psychoactive Substances (NPSs) represent a prominent and increasing concern for forensic laboratories across the country. Benzodiazepines belong to one class of NPSs that has seen a growing presence in the United States. The rise of benzodiazepines, driven predominantly through the increased production and prevalence of counterfeit pharmaceutical tablets, may lead to another drug epidemic. The development of new techniques, or new methods for existing techniques, allowing for rapid detection and identification of these compounds is required for laboratories to rapidly respond to this emerging concern.

There is an increasing need for rapid, reproducible, and precise identification of NPSs such as benzodiazepines to assist presumptive and confirmatory analyses. As drug units across the country are facing overwhelming backlogs, the ability to rapidly characterize a drug sample, from a field collection, a swipe, or an extract, with a highly specific and reproducible screening technique could provide substantial progress in both reducing case backlog and lowering turnaround time. TD/DART®-MS was investigated in this work as a technology that can face these challenges. TD/DART®-MS, which is a modification of DART®-MS that incorporates a thermal desorption unit, has been shown to provide increased reproducibility, sensitivity, and analyst safety compared to traditional analyses. This modification also allows for analysis via swipes, instead of glass capillary tubes, which has been demonstrated to be an effective way to screen evidence or evidence packaging. This project aimed to develop and understand the capabilities to detect benzodiazepines using TD/DART®-MS.

The initial component of this study used a design of experiments approach to determine the key instrumental parameters and led to the creation of an optimized method. Parameters that were optimized included: DART® ionization gas, Vapur flow rate, thermal desorber temperature, and DART® exit grid voltage. The optimized method was then used to collect representative spectra and create a library at different fragmentation voltages for a suite of 19 different benzodiazepines. Sensitivity of the method was then determined by calculating the limit of detection for a select number of compounds and was found to be on the order of single nanograms per swipe. Studies were also completed to identify the effect common cutting agents, such as stearic acid, mannitol, lactose, and caffeine, and additional drugs, such as heroin, had on the ability to detect the benzodiazepines in mixtures. Additionally, the incorporation of three complex background matrices for swipe-based collection (fingerprints, dirt, and plasticizers) to the samples was completed to test potential ion suppression. Real case samples were also analyzed to demonstrate the utility of the technique for a practicing forensic laboratory.

This work demonstrates that rapid detection of benzodiazepines with nanogram sensitivity is achievable using TD/DART®-MS with minimal issues caused by complex matrixes and mixtures. The detection of low sample quantities can be advantageous to forensic scientists as it provides a sensitive and rapid analysis of target analytes using swipes of evidence packaging, evidence itself, or extracts.

Drug Analysis, TD/DART®-MS, Benzodiazepines

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