B199 From Plants to Projectiles: New Analytical Approaches to the Utility of Direct Analysis in Real Time (DART®) Technology in Forensic Cases

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After attending this presentation, attendees will better understand two new applications of Direct Analysis in Real Time Mass Spectrometry (DART®-MS) technology in forensic science for the characterization of trace evidence off the surface of spent projectiles as well as the characterization of psychoactive compounds from interesting plant-based drugs of abuse.

This presentation will impact the forensic science community by demonstrating the applicability of DART® technology, a rapid, ambient ionization technique for relevant evidentiary materials in forensic cases from plants to projectiles.

This two-part presentation will address new application areas of DART®-MS: non-destructive characterization of trace evidence from the surface of projectiles and the evaluation of DART®-MS as a rapid analytical technique for the characterization of non-traditional, plant-based drugs of abuse. The purpose of the first part of this study was to examine the feasibility of trace material identification from the surface of spent bullets using DART®. The goals of the second part of this research were to develop methods for the analysis of a wide variety of plant-based drugs of abuse and to apply these methods in an effort to differentiate between multiple strains of seed species.

The examination of trace amounts of intermediate target materials collected on the surface of spent projectiles provides crucial information for trajectory reconstruction. Determining the origin of an unknown material adhered to a spent bullet allows for the identification of intermediate targets the bullet either contacted or penetrated during flight. Although significant information can be obtained, this aspect of trajectory reconstruction is often ignored. The ability of different bullet types to collect trace materials from intermediate targets and the ability to associate these materials to their origin was examined using microscopy and DART®-MS. Full metal jacket, jacketed hollow point, and lead round nose bullets were fired into sheets of five different commonly used building materials. All spent bullets were examined and photographed using a stereomicroscope. The spent bullets were then examined using DART®-MS to determine if any ion profiles generated from the trace materials could be associated with those of the intermediate target building materials through which the bullets were fired. The collection of trace from all five types of building materials was highly dependent on the type of bullet. The trace materials collected produced unique and interpretable ion profiles. Additionally, MS data from four of the five building materials tested matched the MS data generated from trace material collected on bullets from the respective target materials.

For the second part of this study, 12 different seed species reported to have psychoactive effects on the user were obtained and analyzed. Many plant species around the world are known to contain various psychoactive compounds. Due to their effects when consumed, many of these plants are used as a part of religious and ritualistic practices in many different cultures. As with any psychoactive compounds, these plants have the potential to be used in a recreational manner. In the United States, plant-based drugs of abuse, such as marijuana, have become commonly abused substances. Although the federal government currently regulates marijuana, many of the plant materials containing potential drugs of abuse are not regulated and can be purchased legally from various online sources. Physical examination was performed, in which average measurements were obtained to describe the length, width, thickness, and mass of each seed species, followed by DART®-MS analysis. The seeds were prepared for analysis by DART®-MS by grinding to homogenize the seed and embedding the powder onto QuickStrip™ cards. To optimize the method for analysis, three different DART® carrier gas temperatures were investigated for each sample by considering the signal to noise ratio, ion abundance, and presence of the analyte of interest at each source temperature using a single quadrupole mass spectrometer. The analytes detected were then subjected to MS^n fragmentation in a quadrupole ion trap mass spectrometer to confirm the identity of the analytes being detected. Fragmentation patterns were then compared to known fragmentation patterns reported within the literature, by other ionization methods such as: chemical ionization, atmospheric pressure chemical ionization, and electrospray ionization.

Forensic Chemistry, DART®-MS, New Approaches