K19 An Analysis of Drugs and Their Metabolites in Saliva and Urine Using Various Swabs in Conjunction With Direct Analysis in Real-Time Mass Spectrometry (DART®-MS)

Nicholas L. Drury, BSc, The George Washington University, 510 21st Street, NW, Apt 216, Washington, DC 20006; Nicholas T. Lappas, PhD, The George Washington University, Mount Vernon Campus, 2100 Foxhall Road, LO5 Somers Hall, Washington, DC 20007; and Mehdi Moini, PhD, The George Washington University, Dept of Forensic Sciences, 2100 Foxhall Road, NW, Washington, DC 20007*

After attending this presentation, attendees will be able to: (1) understand the application of DART®-MS to the analysis of illicit drugs and their metabolites on various swabs used in routine drug testing applications; (2) understand the pros and cons of toxicology analysis of buccal swabs and urinary swabs by DART®-MS; and, (3) understand the effects of swab composition, drug type, drug polarity, and collection time on the sensitivity of drug detection in biological samples.

This presentation will impact the forensic science community by improving examiner knowledge of the variables involved in the analysis of oral fluid and urine for the detection of drugs of abuse using DART®-MS as a detection technique for swab analysis.

Hypothesis: Application of DART®-MS is gaining momentum in the forensic sciences due to its fast analysis time and minimal sample preparation. In toxicology casework, various swabs may be used for oral fluid collection and analysis. Though not popular, urine may also be sampled by a swabbing technique after being donated by the testee to concentrate any drugs present in the urine onto the swab tip.[1-3] These swabs may vary in their performance based on the method used for identification of drugs on these swabs, the composition of the swabs (hydrophobicity/hydrophilicity of the fibers), the physical properties (solubility, acidity/basicity, etc.) of the drug, and other factors.

Methods: Positive ion mass spectra were acquired using a DART® ion source interfaced to an AccuTOF™ mass spectrometer. To test the utility of swab sampling techniques for the analysis of drugs by DART®-MS, four different types of swabs were used: CVS™ brand cotton swabs, 155C rayon swabs, and two polypropylene applicators, 4508C FLOQSwabs™ and 4504C FLOQSwabs™, with different tip shapes. Solutions of lidocaine, procaine HCl, diphenhydramine HCl, and quinine monohydrochloride dihydrate were prepared in concentrations ranging from 1mg/ml to 1ng/ml. Specificity, Limit of Detection (LOD), and Linear Dynamic Range (LDR) were established for each swab variant. Next, the method was applied to multiple illicit drugs and metabolites, including cocaine, Δ^9-tetrahydrocannabinol, benzoylecgonine, and 11-nor-9-carboxy-Δ^9-tetrahydrocannabinol. These drugs were used to determine the correlation between: (2) swab fiber polarity; (2) drug polarity; and, (3) sensitivity. These drugs were spiked into synthetic urine or synthetic oral fluid in concentrations ranging from 100ug/ml to 1ng/ml. Each swab was submerged in the solution for 3s and analyzed via DART®-MS.

Results: There was a positive correlation between swab fiber polarity, drug polarity, and sensitivity of drug analysis. When urine or oral fluid solutions of polar drugs were sampled with polar rayon or cotton swabs, sensitivity was an average of ~10X-20X compared to polypropylene applicators. When urine or oral fluid solutions of non-polar drugs were sampled with the non-polar polypropylene applicators, sensitivity was ~10X-20X lower. When polar drugs in urine or oral fluid were sampled by the swabs, peak intensities were greatest for non-polar swabs, followed by more polar swabs. Non-polar drugs gave the highest peak intensity when cotton swabs were used. The two polypropylene applicators are composed of the same fibers, but have different tip shapes; 4508C is slightly more rounded than 4504C, and 4508C always had a higher peak intensity versus 4504C, showing the impact that swab tip shape has on sensitivity. The application of these techniques to the analysis of various synthetic drugs will be presented.

Reference(s):

1. Casolin, Armand. 2016. Comparison of Urine and Oral Fluid for Workplace Drug Testing. *Journal of Analytical Toxicology.* 40 (7): 479-485. doi:10.1093/jat/bkw055. http://www.ncbi.nlm.nih.gov/pubmed/27344042.
2. Drummer, Olaf. 2006. Drug Testing in Oral Fluid. *Clin Biochem Rev.* 27 (3): 147-159. https://www.ncbi.nlm.nih.gov/pmc/articles/ PMC1579288/.
3. Lesiak, Ashton D., Rabi A. Musah, Robert B. Cody, Marek A. Domin, A. John Dane, and Jason R.E. Shepard. 2013. Direct Analysis in Real Time Mass Spectrometry (DART-MS) of Bath Salt Cathinone Drug Mixtures. *The Analyst.* 138 (12): 3424-3432. doi:10.1039/c3an00360d. http://www.ncbi.nlm.nih.gov/pubmed/23636110.

DART®-MS, Swabs, Forensic Toxicology

*Presenting Author