B160 The Material Effects of Commercial Swabs on the Extraction of Multiple Drugs Using Microfluidics and Mass Spectrometry

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After attending this presentation, attendees will understand how different materials of commercially sold swabs can affect extraction and analysis of multiple New Psychoactive Substances (NPS) using a microfluidic extraction device in combination with High-Performance Liquid Chromatography (HPLC) and low-resolution Mass Spectrometry (MS).

This presentation will impact the forensic science community by providing material effects of commercially sold swabs for decisions on better trace evidence collection of NPS and drugs of abuse.

This specific Microfluidic Device (MFD) was developed for the extraction of dyes from fibers and is now being fully tested for other areas of forensic science.[1] This research is a continuation of a presentation given at the 2017 AAFS annual meeting on the comparison of three instrumentation methods for the identification of 70+ drugs. The method developed of collecting the extraction in a micro-vial is used because it extracted, separated, and identified the most compounds, efficiently allowing a valid comparison of material effects.

How materials of commercially sold swabs affect the extraction of certain compounds is the primary goal of this study. This enables forensic specialists to understand what swabs are better for specific NPS for evidence collection. A variety of swabs with tips of materials such as polyurethane foam, cotton, polyester, rayon, and nylon were procured from Puritan Medical Products®. These included a variety of tip types such as flocked or pre-wetted, as well as Popule swabs, which are swabs that contain a small amount of solvent or water in their shafts to saturate the tip for cleaning. To determine material effects, swabs of each material were saturated in a standard solution of 70+ compounds that contain various Differential Optical Absorptions (DOAs) such as amphetamines, cannabinoids, opiates, and barbiturates. To determine trace effects, 10µL of the solution were pipetted onto the swab tips and sampled. Sample preparation for the MFD involved removing a small piece of the swab tip doped with the solution, placing it in the cavity of the microfluidic chip, placing a glass slide on top, and inserting it into the MFD. Extraction commences via the user-friendly interface that controls the parameters and is collected in a micro-vial for HPLC-Triple quadrupole (QqQ) analysis using a method previously developed with Shimadzu Scientific Instruments®, a collaborator on this project. All electronic conditions were the same for ionization and detection parameters, and the QqQ was operated in Multiple Reaction Monitoring (MRM) where multiple product ions are detected for precursor ion identification. An NPS was accurately identified if at least two product ions were detected for the precursor, the signal-to-noise ratio for these ions in the mass spectrum is three or more, and the area of the mass-to-charge ratio signal increases when compared to a blank spectrum collected from the MFD and analyzed.

Results indicate that polyester and polyurethane foam are the most effective at releasing a larger variety of NPS when the tips are fully saturated. Ionization bias caused by electrospray ionization is decreased with this method because the extraction is first separated via HPLC. The lesser amount of NPS identified is simply due to the material effects. For the second method for trace analysis, smaller sized, flocked tips were better since the swab had less depth to absorb the 10µL of solution. This kept the NPS in the same location; thus, the piece removed for extraction and analysis contained most of the drugs. Samples taken from larger swabs rarely contained even half of the compounds as the solution had too much area to spread. This can be improved by sampling multiple areas of one swab. Wetted versus dry Popule swabs revealed that more drugs were released when the Popule contained a solution of 91% Isopropyl Alcohol (IPA) and 9% Deionized (DI) water. Limited variation occurred between dry and wetted swabs when the Popule contained sterile water.

Overall, this work provides forensic analysts with new knowledge for determining swabs to use for evidence collection of trace samples. The MFD adds a simplified extraction step with reduced human error and bias since no analyst interaction is needed during the extraction process. It shows versatility for extraction of drugs from a variety of materials, where only the effects of the materials cause different NPS to be identified. This work benefits the forensic community by fast, automated extraction, simple transfer into the HPLC/MS system, facilitated identification with a low-resolution MS instrument by MRM, and simplified confirmation of identification via comparison with the blank spectrum of the MFD.

Reference(s):

1. Patrick, Sean, Douglass Design, Microfluidic Dye, Sean Patrick, and Douglass Gunning. 2014. *Design of a Microfluidic Dye Extraction Device for Fiber Identification.* North Carolina State University.

Multiple Drug Analysis, Material Effects, Microfluidic Mass Spectrometry

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