B111 A Comparison of Methods of Analysis for the Extraction and Identification of Drugs Using Microfluidic Mass Spectrometry (MS) From Different Substrates

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After attending this presentation, attendees will better understand the utilization of a microfluidic extraction device and how, in conjunction with High Performance Liquid Chromatography (HPLC) and high- and low-resolution MS, it allows for accelerated analysis of multiple drugs of abuse in a single sample run.

This presentation will impact the forensic science community by introducing multiple methods for accelerated analysis of numerous drugs (up to 70) at the same time, which can aid in determining the efficiency of the system depending on the Microfluidic Device (MFD) MS instrumental set up.

This specific MFD was originally developed for the extraction of dyes from fibers; however, it is now being fully tested for other areas of forensic science that use extraction, such as inks on questioned documents or analgesic tablet analysis. Benefits of this device include: (1) smaller amounts of sample needed, allowing for less damage to the evidence; (2) less contact between the examiner and the evidence, allowing the integrity of the evidence to be kept intact; and, (3) speed of extraction, which is generally less than five minutes per sample run.[1]

The primary focus of this presentation is to compare the different methods of MFD-MS to illustrate the versatility of the device and to describe how high-resolution MS can be utilized for facilitated identification of the extracted drugs. Increasing the efficiency of drug analysis is essential in the forensic community simply because it allows for faster analysis of data, meaning rapid identification of the drugs used by perpetrators. Also important is ensuring that the majority of the evidence is kept accessible if later testing is needed, which this extraction device enables.

In these experiments, the MFD was used to extract a standard solution containing 70+ drugs from multiple substrates including Quantisal™ saliva collection devices, cotton swabs, paper, and more. Multiple instrumental set ups of the MFD-MS were tested: (1) directly connecting the MFD to the Shimadzu® LCMS-8060 series Triple quadrupole (QqQ) MS and directly injecting the sample into the MS; (2) extracting the sample using the MFD and introducing the extraction to HPLC for separation, then analysis via the QqQ MS; (3) extracting the sample using the MFD, adding 2mL of Methanol (MeOH) to enhance solubility and ion signal, and analysis through HPLC/MS; and, (4) connecting the MFD to the HPLC system using a T-valve for direct connection into the HPLC/MS system. These methods were also compared using the MFD attached to a different MS instrument, specifically, an Agilent Technologies® 6520 series quadrupole Time-Of-Flight (qTOF) MS. Comparison of analysis via these MS instruments demonstrates the diversity of compatibility this MFD possesses. The efficiency of each set up was compared by determining the number of drugs identified from a known standard solution of 70+ drugs. Sample preparation for all substrate types can be generalized in the following steps. First, a sample of the standard drug solution containing the 70+ drugs was administered onto the substrate (~2mL-3mL). Second, using either scissors or a Harris® micro-punch tool, a small portion (~0.5mm-2mm) of the substrate was removed. Third, the removed sample was placed in the sample cavity of the MFD sample chip and inserted directly into the MFD. From there, a computer program determining the number of flushes of solvent into the cavity for extraction was selected, and the process began.

In conclusion, the experiments conducted reveal the versatility and diversity of this MFD for extraction of multiple drugs on multiple different substrates, and also exhibits its compatibility with different MS instruments, which is beneficial as many crime laboratories have different instruments available. This MFD-MS and MFD-HPLC/MS set up will allow accelerated analysis of multiple drugs, increased integrity of evidence, and less contact between the evidence and the examiner, which are all essential for forensic analysis today.

Reference(s):

1. Patrick S., Design D., Dye M., Patrick S., Gunning D. *Design of a Microfluidic Dye Extraction Device for Fiber Identification.* 2014.

Drug Analysis, Mass Spectrometry, Microfluidics