A139 Determination of Organic Gunshot Residue With Solid Phase Microextraction by GC/MS

Brent A. Casper, BS, University of Kentucky, A061 ASTeCC Bldg, Lexington, KY 40506; and Bert Lynn, PhD, University of Kentucky, A053 ASTeCC Bldg, Lexington, KY 40506*

After attending this presentation, attendees will become familiar with how Solid Phase Microextraction (SPME), coupled with Gas Chromatography-Mass Spectrometry (GC/MS), can be used to effectively detect organic gunshot residue (OGSR) from articles of clothing.

This presentation will impact the forensic science community by providing a quick and efficient method to detect OGSR on a suspect's clothing. Additionally, while utilizing equipment currently present in most labs, forensic labs will be presented with an alternative method to determine if an individual has fired a gun.

Traditionally, GSR has been evaluated by elemental analysis of inorganic particles such as lead, barium, and antimony by the technique of Scanning Electron Microscopy with Energy Dispersive X-ray analysis (SEM-EDX). This method has provided the benchmark for GSR analysis within the legal system for decades. Although the technique of SEM-EDX is very effective, it also has the disadvantage of being time consuming and labor intensive.[1]

As times change, the compositions of ammunitions are also evolving. More environmentally friendly formulas remove lead, and replace it with other less toxic elements such as aluminum.[2] The traditional method of analyzing GSR by SEM-EDX, which relies on the presence of these inorganic elements, is becoming obsolete as manufactures change the composition of their ammunitions to more environmentally sustainable formulas. This has placed the forensic community at a disadvantage when it comes to GSR analysis, but at the same time also gives new opportunities to create alternative methods to solve such problems.

The goal of this study is to determine if OGSR can be captured by SPME and analyzed by GC/MS to establish if an individual fired a gun. OGSR can originate from many components of ammunitions including primers, propellants, and stabilizers—all of which contain different compounds classified as OGSR. Some of these compounds include diphenylamine (DPA), N-nitrosodiphenylamine, ethyl centralite (EC), and methyl centralite (MC). The compounds ethyl and methyl centralite are both unique compounds to OGSR, and can be used as an identifier compound to place a suspect at the scene of a shooting.[3]

For this research, articles of clothing were collected in sealed cans for transportation and analysis. The OGSR was moved from the clothing into the headspace of the can by applying heat in an oven. The SPME fiber was then exposed to the headspace to extract the OGSR. After the headspace extraction, the OGSR was desorbed from the SPME fiber into the heated injection port of the GC/MS for analysis. A 75µm Carboxen-PDMS (Supelco Bellefonte, PA) SPME fiber was chosen to perform the extraction with a Shimadzu GC/MS-QP5000 (Kyoto, Japan) for the analysis. To make the analysis more selective, a selected ion monitoring (SIM) method of known OGSR compounds was used to perform the analysis. Test firings/samples were conducted at a local shooting range.

Preliminary data has demonstrated that a cloth doped with OGSR compounds DPA, EC, and 2,4-dinitrotoluene can be extracted and analyzed with SPME-GC/MS. Initial findings have also shown that when a gun is discharged, a cloud of OGSR does adhere to cloths placed around the shooter, with some of these compounds being extracted when analyzed. Additional experiments are being conducted to determine if a correlation is present between certain compounds and individual brands of ammunitions. The preliminary data has shown that using SPME-GC/MS as the means of extraction and detection will provide a fast and accurate method for the analysis of OGSR evidence.

References

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GC/MS, Organic GSR, SPME

 ** Presenting Author*