B22 An Analysis of Smokeless Powders, Smokeless Powder Residues, and Pyrolysis Products by Gas Chromatography/Mass Spectrometry (GC/MS)

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Learning Overview: After attending this presentation, attendees will understand the analysis and classification of smokeless powders and post-burn smokeless powder residues, as well as how the pyrolysis products generated in the residues are related to the compounds present in the unburned samples through GC/MS.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating how the pyrolysis products generated through the burning of smokeless powders may be related to the intact smokeless powder. The research presented herein may aid in providing a link between a suspect and a crime scene and may be applied to analyses such as organic gunshot residue analysis or analysis of debris after an explosive event.

Following an explosive event, such as the detonation of an improvised explosive device or discharge of a firearm, intact or partially burned smokeless powder particles and burned smokeless powder residues may be recovered. Therefore, to best simulate possible real-world evidence, intact and burned samples were analyzed. Intact smokeless powders were extracted for GC/MS analysis through a simple extraction procedure set forth by the National Center for Forensic Science, using Dichloromethane (DCM) and an internal standard of undecane. Smokeless powders were burned to generate smokeless powder residues. The residues were extracted from foil with approximately 2mL DCM, followed by evaporation and reconstitution in 250µL DCM with an *n*-tetracosane internal standard. Additionally, standards of common smokeless powder compounds, such as nitroglycerin and ethyl centralite, were burned in the presence of Nitrocellulose (NC) to generate pyrolysis products for each compound individually that could be compared with the residue of actual smokeless powder samples. An individual sample of NC pyrolysis products alone was also generated to determine pyrolysis products of NC that may be observed in all samples. The pyrolysis product residues were extracted in DCM. All extracts were analyzed via GC/MS to allow for identification of smokeless powder compounds and pyrolysis products present from each compound and in the smokeless powder residue. GC/MS parameters were optimized for each sample type prior to analysis.

Organic compounds of interest were easily identified in smokeless powders, smokeless powder residues, and individual compound pyrolysis products. The residue composition may then be related to the intact smokeless powder composition. Pyrolysis product peaks were identified in the smokeless powder residue extracts using the data gathered from the individual compound pyrolysis products. Additionally, Pearson correlation coefficients were calculated between the smokeless powders and smokeless powder residues, as well as the smokeless powder residues and pyrolysis samples to determine the similarity in their resulting patterns.

GC/MS is a standard method for analysis that is widely available to investigators. Thus, analysis and characterization of smokeless powders and smokeless powder residues via GC/MS may be beneficial to the forensic community. Additionally, the ability to characterize smokeless powder residues and relate the residues to an original powder composition may be helpful in determining the brand or origin of a suspect sample and provide a link for investigators between a suspect and crime scene.

Smokeless Powder, Explosives, Organic Gunshot Residue

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