B163 Analyzing Latent Print Chemistry Using 2D Gas Chromatography

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Learning Overview: After attending this presentation, attendees will have learned of another way of analyzing latent prints based on the chemistry in addition to evaluating the quality of the print and how different correlation statistical methods, such as Pearson's correlation, aids in inter- and intra-variability based on the participant's chemical composition.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by presenting a new instrumental technique in analyzing latent print chemistry that would be a supplement to traditional latent print examination.

Latent print evidence when received from a crime scene are analyzed and compared by examiners using the Analysis, Comparison, Evaluation-Verification (ACE-V) protocol. This accounts for the analysis of the questioned print using Type 1, 2, and 3 minutia details, comparing it to a known exemplar print either obtained from the Automated Fingerprint Identification System (AFIS) or any potential suspects. However, there may be benefit to the community to evaluate the chemistry of the latent print in addition to the analysis of physical minutiae because the chemistry of the naturally secreted sweat and oils is relatively consistent, aside from illnesses and the use of personal hygiene products (e.g., lotions, hair oils, etc.).

Over the years, researchers have evaluated the use of various instrumental techniques in analyzing latent prints, such as Gas Chromatography/Mass Spectrometry (GC/MS), matrix-assisted laser desorption/ionization, and Raman and infrared spectroscopy. GC/MS has been used in latent print studies in identifying lipids and amino acids observed in different volunteer groups based on age, gender, and ethnicity, along with determining the age of the print from deposition to collection; however, there are areas where co-eluting compounds were present within the chromatograms that could decrease the potential of accurate associations or discrimination between unknown and known comparison latent prints.

In this research, 2D GC/MS was used to determine if latent prints could be linked to a source. Statistical techniques, such as Pearson's correlation coefficient, was used to determine the inter- and intra-correlation values between latent prints deposited by various volunteers. In a second study, it was determined latent prints could be classified into either age, gender, or race/ethnicity groups based on chemical composition. Latent print samples collected from volunteers were deposited onto a microscope slide and a microfiber filter, which were extracted using dichloromethane or hexane, and evaporated under nitrogen. To afford for better chromatographic separation and detection along with decreasing volatility, the samples were derivatized before GC analysis. Boron Trifluoride in Methanol (BF_3-MeOH) and n-Methyl-n-(trimethylsilyl)Trifluoroacetamide (MSTFA) was used for sample derivatization, and the reagent that displayed the better peak identification based on percent quality match, abundance, and reproducibility was used for the duration of the study.

The results of the latent print samples were subjected to compound identification and compared visually for similar/dissimilar peaks between volunteers. The latent print samples were either linked back to a source using Pearson's correlation values or categorized into a class (i.e., race, gender, or race/ethnicity) using principal component analysis and k-nearest neighbors. Error rates were determined to test the validity of the statistical methods described for the samples obtained from the 2D GC/MS.

Latent Print Chemistry, 2D GC/MS, Association Error Rates