

COFSE Research Newsletter

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Fall - 2019

LEAP's Mission

Bridging the Gap

This program facilitates collaborative research between academia and forensic science laboratories. This joint effort between the American Society of Crime Lab Directors and the Council of Forensic Science Educators identifies forensic science needs and provides a platform for laboratories, researchers, and students seeking projects aligning with their mutual research capabilities.

RESEARCH IN THE COMMUNITY

Trace Evidence

Combined Inorganic/Organic Gunshot Detection

PI: Candice Bridge, Ph.D.

University of Central Florida, FL

This research was centered on determining a colorimetric solvent system that can detect organic GSR components without affecting the metallic IGSR particles for subsequent SEM-EDX analysis. This will allow investigators to perform color tests in the field for rapid detection while allowing for instrumental lab analysis of the same sample. This prevents splitting the sample in two and reducing the population of components. In this study, 4-nitrosophenol, nitrous acid, and sodium borohydride were evaluated OGSR detection and ensuring that it doesn't adversely affect SEM-EDX analysis of IGSR. We determine that sodium borohydride is the most specific and sensitive without hindering subsequent SEM-EDX analysis.

Crime Scene Investigation

Cobalt Chloride as an Enhancement Reagent for Two-Dimensional Footwear Impressions Containing Ice Melt Product Residue

PI: Lawrence Quarino, Ph.D.¹

Co-PI: Kevin Karakkat, Ted Schwartz²

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Cobalt is a transition metal that is suitable to form coordination complexes with Lewis bases and is most commonly found as cobalt chloride hexahydrate. Given that ice-melt products typically contain moieties with free electron pairs (and thus can serve as a Lewis base) such as chloride salts or urea, the potential use of cobalt chloride hexahydrate as an enhancement reagent for footwear prints containing ice melt products was investigated. Footwear impressions were made on nine different substrates from aqueous solutions of seven commercial ice melt products of different compositions. To dried footwear impressions, an aqueous 20% (weight/volume) cobalt chloride hexahydrate solution was sprayed evenly. In most cases, a heated blow dryer was then applied over the imprint to turn the color of the enhancement from a lighter pink (the color of cobalt chloride hexahydrate) to the darker blue-purple (the color of anhydrous cobalt chloride) which typically yielded better contrast. Enhancements were obtained with all product compositions except one product containing calcium magnesium acetate. In general, diatomic chloride salts yielded better enhancements than those made from products containing monoatomic chloride salts. Products containing urea or proprietary formulations containing amides also produced good enhancements. The quality of the enhancement was affected by the porosity and texture of the substrate. (Published: *Journal of Forensic Identification*, 66, 2016).

Entomology & Crime Scene Investigation

The Novel Use of Larval Masses as Cadaveric Odor Sample Sources

PI: Paola A. Prada-Tiedemann, Ph.D.

Texas Tech University, TX

Forensic entomology has played a role in forensic investigations by estimating the postmortem interval (PMI) using insect succession, determining the possible movement of a body by identifying insect species at the site of the crime, and even in entomotoxicology where the carrion flies can accumulate drugs ingested by the deceased. Research in regards to larval odor samples has focused on chemical composition in relation to specie identification and age development, however, no study has attempted to correlate larvae odor profile with decomposition stage on an active decomposition model. To address this gap in knowledge in forensic taphonomy, efforts in my laboratory employ swine animal models in the dry arid region of West Texas to determine whether maggot samples provide stage-specific decomposition odor profiles across seasonal changes. With the information from the larval mass odor, the utilization of insects as a sample matrix can potentially be implemented by forensic scientists using volatile biomarkers as indicators of postmortem intervals. While the sample specimen and the established techniques are not novel, the information extracted from a maggot sample is revolutionizing in that no other research has questioned the feasibility of this bio-specimen to render a set of potential biomarkers across temporal composition changes. Thus, the evaluation of this novel research question can provide the framework for an advanced, cutting edge approach model that could be extended to various locations for use. The research has been able to compare animal tissue samples with larvae and compare/contrast decomposition odor signatures.

Trace Evidence

Forensic Applications of Gunshot Residue (GSR) and Paint Analysis Using Laser-Induced Breakdown Spectroscopy (LIBS)

PI: Rosemarie Chinni, Ph.D.

Alvernia University, PA

In LIBS, a laser pulse focused on the sample's surface heats, ablates, atomizes, and ionizes the surface material and results in the formation of a plasma. The plasma emits light, which is collected, spectrally resolved, and detected. The unique elemental emission lines are used to identify the elements contained within the sample. Two forensic science applications of LIBS will be discussed here.

A GSR cloud formulates and dwells in the immediate area where any firearm is triggered, leading to residue residing on the shooter's person, and can also be breathed in through the nasal cavity of the shooter. LIBS was used to determine the best nasal swab for the study and to specifically determine the presence of barium, lead, and antimony, which are inorganic components of most GSR, before and after shooting. Final results gained from a 12-shooter study showed that the detection of Sb was not conclusive and most likely not seen due to its low concentration in the original primer. Lead and barium were found 92% and 100% of the time in all shooters in both 1 and 10 shot data, respectively. The next phase of this study is to calculate a detection limit for the Pb and Ba that can be collected on the swabs.

The paint analysis research could apply to indirect dating, authentication, and identification of oil paint pigments. The sample analysis consisted of ten oil paint pigments from traditional to modern palettes and each were analyzed in their pure form and in various binary mixtures. The data was taken using 10 shot accumulation for comparative studies to determine the best possible emission lines that can be used to uniquely identify the pigment. Single shot analysis was used for depth profiling which showed the transformation of the spectra as each layer of paint, primer, and canvas was ablated revealing the layer beneath.

DNA/Biochemistry

The Prevalence of Male DNA under a Female's Fingernails

PI: Janine Kishbaugh, Ph.D.¹

Collaborators: Alexis Baxter¹, Elayne Schwartz², Holly O'Connor²

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The frequency of finding male DNA under a female's fingernails is not currently fully understood by the scientific community. When a victim comes into contact with a male assailant during a violent or sexual assault, DNA analysis is performed in an attempt to find the presence of foreign male DNA on the victim. Evidence is collected with a sexual assault evidence kit which includes cutting, scraping or swabbing of the victim's fingernails. However, finding male DNA may not necessarily reflect the context of how the transfer occurred and may not be the profile of the assailant. Considering that the sensitivity of DNA methodologies is continually improving, we may be detecting previously undetectable DNA that is actually being transferred through casual contact and unrelated to the crime. In addition, secondary and even tertiary transfer may be detected.

Previous studies have shown that the origin of foreign DNA under fingernails can be associated to cohabitants [1]. Assessing the random nature of male to female transfer throughout the day is the basis for this study. Y-STR's were used for typing of detected foreign DNA. Female participants in this study either lived with or frequently encountered male individuals in their daily lives. All samples were collected via cutting with fingernail clippers. All nails from one hand were combined and analyzed together, for a total of two sets per collection. Extraction was performed on the fingernails using a QIAamp® DNA Investigator kit. Quantitation was not performed in this study due to the amount of male DNA being extremely low. Amplification was performed with the PowerPlex® Y23 system. Genotyping was performed using an Applied BioSystems 3130XL and fragment analysis was performed with GeneMapper® IDX v1.5. Thirteen females participated in this study, resulting in 74 samples that were analyzed. Two participants did not complete all three collections. Of the samples tested, partial and full profiles were produced from single and multiple contributors. In some cases, profiles were linked to males associated to the participant via reference profiles provided. When the male reference profile was detected, most allele calls were associated with that individual. Mostly partial profiles were obtained in this study, it is hypothesized that full male profiles obtained during casework may be more indicative of close, immediate contact between the victim and a male. Also, since the male reference profile contributed to most allele calls, any foreign alleles present should be carefully interpreted.

1. Malsom S, Flanagan N, McAlister C, Dixon L. The Prevalence of Mixed DNA Profiles in Fingernail Samples Taken from Couples who Co-habit Using Autosomal and Y-STRs. *Forensic Sci Int Genet* 2009; 3:57-62.