

MAAFS 2019 - Criminalistics Section Paper Presentation Abstracts

Thursday, May 9th

Trace Evidence: Then, Now and Moving Forward

Tatiana Trejos - West Virginia University*

This presentation will discuss the current status of trace discipline in the United States, how the scientific foundations have been established, what the main challenges are, and what steps are needed to strengthen the role of trace evidence in the criminal justice system. The importance of enhancing the perceived value of trace evidence, beyond source attribution, in reconstruction and intelligence investigations is often overlooked. As a result, we will exemplify the relevance of material-specific base-knowledge in informing decisions during a case pre-assessment, the collection and sampling steps, and the overall interpretation of the evidence. Fibers, tape, paint and glass cases will be used to illustrate the underlying validity of methods and interpretation approaches.

Modern Fast Screening of Inorganic and Organic Gunshot Residue (GSR) by Laser-Induced Breakdown Spectroscopy (LIBS) and Electrochemistry (EC)

Korina Menking-Hoggatt, Tatiana Trejos, Ph.D., Luis Arroyo, Ph.D. - West Virginia University*

The detection of GSR is crucial during the investigation of firearm related crimes, but there is a large discrepancy in the amount of time taken to respond to the crime, and the forensic examiner's ability to process the evidence collected; the former can take minutes, while the latter can take months. The goal of this study was to develop a reliable screening approach capable of detecting Gunshot Residue (GSR) in just a few minutes by taking advantage of the minimally destructive nature, high specificity and sensitivity, and the ability for micrometer scale spectrochemical mapping of the evidence using LIBS and electrochemical sensors. The techniques apply the universal sampling and collection method currently used by practitioners, and still remains compatible with current standard of Scanning Electron Microscopy-Electron Dispersive X-ray Spectroscopy (SEM-EDS) because over 99% of the stub is left unaltered for further analysis. A validation set of over 300 samples originating from non-shooters and known shooters resulted in an overall accuracy between 98-100%, depending on the dataset and the type of classification or prediction model applied. The incorporation of this rapid screening approach into the current protocol of GSR examination could offer a more streamlined and efficient management of casework by offering selective on-site detection capabilities, minimizing unnecessary confirmatory analysis of negative samples, and processing positive samples faster.

Ignitable liquid classification of small engine fuels and a survey of accelerant detection canine responses

Lisa Schwenk - Bureau of Alcohol, Tobacco, Firearms & Explosives*

Small engine fuels (SEFs) have been developed as pre-mixed, ethanol-free fuel alternatives for 2-cycle equipment. A variety of brands and mix ratios of SEFs were analyzed and classified by their ignitable liquid content. They were determined to contain a mixture of aromatic and isoparaaffinic products. Responses by ADCs in a blind study as well as several case examples where the presence of an SEF was suspected will be discussed.

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Attribution Signatures for Sourcing of Medwakh and Scorpion Dokha

Thomas Orianna, Rachel Alibozek, Amanda Belunis, and Ellen Hondrogiannis, PhD - Towson University*

The purpose of this study was to see if two brands, Medwakh and Scorpion, of dokha (a Middle Eastern tobacco product), could be differentiated based on their elemental properties. Samples were prepared using nitric acid digestion and elemental content measured using inductively coupled plasma - mass spectrometry. Discriminant function analysis was successful at separating both brands. This data can be used to attribute dokha of an unknown origin back to its source.

Breakout Session for Criminalistics Sub-disciplines

Moderator: Cathy Savage - Maryland State Police Forensic Sciences Division

We will be breaking up into smaller groups to discuss challenges or interesting new topics in the specific sub-disciplines for Criminalistics. There will be at least a group for Drug Analysis, Toxicology, Fire Debris Analysis and Gun Shot Residue. Other smaller groups may form as necessary. Please bring your questions and concerns to discuss with other analysts.

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A Novel Approach for Increased Objectivity in Detecting Gunshot Residues Around Bullet Orifices

Courtney Vander Pyl, Oriana Ovide and Tatiana Trejos, Ph.D - West Virginia University*

Currently, the most common method for shooting distance determination and bullet hole identification is performing colorimetric assays that react when lead (sodium rhodizonate test) or nitrites (modified Griess test). While these colorimetric tests are simple and widely used in forensic laboratories, they have significant limitations such as poor selectivity and sensitivity. This research strives to incorporate the use of Laser Induced Breakdown Spectroscopy (LIBS) to improve the scientific reliability of the detection and observation of gunshot residues (GSR) on target materials. The superior selectivity and sensitivity of LIBS analysis, compared to current color tests, increases the objectivity of shooting distance estimations while enhancing the reliability of GSR evidence when presented in a court of law. Additionally, this study is anticipated to aid in crime scene reconstruction when a firearm is involved in a criminal event.

Determining the Method Threshold of Identification via Gas Chromatography-Mass Spectrometry of Weathered Gasoline Extracted from Burnt Polyester Carpet

Stacy Davis, Ellen M. Hondrogianis Ph.D. - Towson University*

The purpose of this work is to quantitatively determine the threshold of identification of weathered gasoline extracted from burnt polyester carpet. Identification of gasoline was confirmed if the base peak to qualifier ion ratios of target compounds in the extracted (using ASTM 1412) weathered gasoline fell within $\pm 25\%$ of the same compounds in the neat gasoline. Incorporation of ion ratios into the ignitable liquid identification process will allow analysts to go beyond pattern matching and instead use an identification process that relies on quantifiable data.

Putting the Pieces Together: Developing and Applying a Systematic Method for the Comparison of Duct Tape Edges

Meghan Prusinowski, Evie Brooks, Tatiana Trejos - West Virginia University*

The conclusion of a fit between edges is considered the highest degree of association for forensic duct tape examinations, yet relies exclusively on the examiner's opinion to identify distinctive features across the tape ends. This study aimed to establish, for the first time, a systematic method to qualify and quantify tape end fracture features, and evaluate if experimental data support the assumption that random tape physical fits are unlikely. Approximately two thousand blind tape end comparisons (hand-torn and scissor-cut duct tape samples, stretched and pristine samples of various grades) were evaluated by two independent examiners, and the occurrence of false positives and false negatives was calculated, along with score likelihood ratios to identify thresholds of strong support for the conclusion of match or non-match. The overall accuracy of the examinations for the medium quality tapes ranged from 99.6% to 99.8% (hand-torn and scissor cut, respectively) and 84.9% for the high quality hand torn tapes. The results of this study are anticipated to offer an effective strategy to qualify and quantify distinctive features in tape end examinations and to serve as a scientific foundation to develop standard methods that complement and substantiate the examiner's opinions.

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Quantitation of CBD and THC in commercially available CBD-oil Supplements by Gas Chromatography-Mass Spectrometry

William Moats, Michael Cipoletti - Waynesburg University*

CBD oils are quickly becoming popular “nutritional supplements” for many who are seeking the medicinal benefits of cannabis without the psychoactive effects. Because “nutritional supplements” are not reviewed by the US FDA, the efficacy of commercially available CBD oils should be evaluated. Consumers and forensic investigators alike may find interest in not only the potency of CBD in the products, but also potential levels of THC. In this research, a method was developed for the extraction of CBD and THC from CBD oils using acetonitrile followed by GC-MS analysis. Standard curves for CBD and THC were established and several samples of commercially available CBD oil supplements were evaluated for total CBD and THC levels.

Potential Screening Techniques for Indazole-Based Synthetic Cannabinoids

Michael Cipoletti, Alex Freiburger, Steven Piotrowski - Waynesburg University*

National media reports have brought attention to the increase of synthetic drugs entering prison systems through mail services via stationary dosed with synthetic cannabinoids (SynCans). The PA Department of Corrections responded to the upsurge in SynCan soaked mail by copying and storing incoming mail. Recent legal action by civil rights groups has restricted the DOC’s policy from copying and confiscating confidential and privileged attorney-client communications. Additionally, correctional facilities throughout the US are finding SynCans smuggled into prisons in various forms beyond mail and paper. This research explores thin-layer chromatographic and ultraviolet light source screening methods to assist field agents in screening multiple potential matrices containing indazole-based SynCans.

Metabolite elucidation of the synthetic cannabinoids: PX-1, PX-2, PX-3 in human liver microsomes.

Travon Cooman, Suzanne Bell, PhD - West Virginia University*

The use of synthetic cannabinoids (SCs) continue to be a public health concern and an analytical challenge. In this study three SCs PX-1, PX-2, and PX-3 were characterized using human liver microsomes. Oxidative deamination was the common biotransformation between the SCs. Calculated clearance data showed PX-1 as the least cleared. The data is useful to confirm consumption of these SCs from drug screens.

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LC-MS/MS Quantitation of Fentanyl and Metabolites From *Lucilia Sericata* Larvae and Liver Tissue Using a Validated Modified QuEChERS Extraction

Joseph Cox, Colby Ott, Avery Field, and Luis Arroyo - West Virginia University*

In a typical post-mortem forensic toxicological workflow, different specimens are concurrently submitted for opioid testing including: blood, urine, liver, and other tissues. Fly larvae have been used as a toxicological analysis matrix when traditional matrices are no longer available due to skeletonization or to corroborate findings in extremely decomposed tissues. If xenobiotics are present in the body, they have the potential to be ingested by the organisms feeding on the corpse. In this study, a home-made simple sample homogenization system was used for the QuEChERS extraction of fentanyl and two known metabolites, norfentanyl and despropionyl fentanyl (4-ANPP) from maggot and liver tissue samples at various known concentrations. *Lucilia sericata* (common green bottle fly) eggs (250) were reared on beef liver tissue homogenate (200 g) with four concentrations of fentanyl (0, 2.5, 50, 250 µg/Kg) and allowed to develop into third instars. Extraction protocols were validated using ASB guidelines.

Synthetic Drug Surveillance in Public Health

Brandon Jones, Luke Short - Washington, DC Department of Forensic Sciences*

The Forensic Chemistry Unit at the Washington, DC Department of Forensic Sciences has established an enhanced surveillance program for opioids and other synthetic drugs. The program monitors all heroin submitted to the district regardless of court status. This presentation will summarize the results of the surveillance program, including the discovery of eight synthetic drugs new to the District, and its effectiveness in aiding law enforcement intelligence and public health.

SWGDRUG Update

Juli Cruciotti - Virginia Department of Forensic Sciences*

SWGDRUG works to improve the quality of the forensic examination of seized drugs and to respond to the needs of the forensic community by supporting the development of internationally accepted minimum standards, identifying best practices within the international community, and providing resources to help laboratories meet these standards. With new revisions and supplemental documents currently being constructed, an update will be given and the participants are encouraged to give feedback, specifically on Part IIIB and SD-7.

Forensic Electrochemistry and Mass Spectrometry: The Perfect Match to Tackle Fentanyl and other Novel Psychoactive Substances

Colby Ott, Hugo Cunha-Silva, Joseph Cox, M. Julia Arcos-Martinez, Luis Arroyo - West Virginia University*

Screen printed electrodes were employed for the analysis of fentanyl and novel psychoactive substances (NPS). Electrochemical detection of these substances was achieved through square wave voltammetry using adsorptive stripping and differential pulse voltammetry. Various electrode modifications including gold and rhodium nanoparticles were employed in attempts to improve detection capabilities. Parameter optimization was performed and resulted in initial detection capabilities of approximately 75 ng/mL (ppb) for fentanyl and 200 ng/mL (ppb) for PB-22. Validation of a confirmatory detection method in oral fluid using LC-QqQ-MS was performed according to ASB guidelines.