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10. Forensic Science

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Abstracts from the 2014 Oklahoma Research Day

Held at the University of Central Oklahoma

5. Mathematics and Science

10. Forensic Science

05.10.01 Stability of Synthetic Cannabinoids in Biological Specimens: Analytical Analysis through Liquid Chromatography tandem Mass Spectrometry

Chelsea, Fort , Thomas Jourdan

University of Central Oklahoma

Synthetic cannabinoids have been a serious problem for law enforcement officials and forensic scientists since their emergence on the retail market where they are packaged as sold as "Spice". These drugs are designed to mimic the effects of marijuana, while giving the user the sensation and peace of mind of a "legal high." The chemical structure and nature of these drugs is highly variable, unpredictable, and often dangerous to the person using a generally at the time "legal" drug. Little is also known about how blood samples secured in cases involving suspected synthetic cannabinoid abuse may degrade under particular storage temperature regimes or for typical prioritized forensic laboratory turnaround times. The particular cannabinoids to be screened will include XLR11, UR144, ADB-Pinaca, and AB-Fubinaca. Since synthetic cannabinoids are newly DEA Schedule I controlled compounds, methods will need to be validated for as to quantitating these four compounds using liquid chromatography tandem mass spectrometry (LC-MS/MS). Validated protocols have been developed in the OCME laboratory based on the current Scientific Working Group guidelines for toxicology labs (SWGTOX). Spiked blood samples will be tested initially on day 0, and then on a specified daily, weekly, and monthly basis for three months. Storage temperature (refrigerator 2°C, room 23°C, and elevated temperature 35°C+) and time since collection will be measured.

05.10.02 Enzymatic Means to Rehabilitate Degraded DNA

Nicole, Sambol , James Creecy

University of Central Oklahoma

A challenge in the field of forensic DNA analysis is the amplification and interpretation of degraded and low-copy number (LCN) DNA obtained from amounts of limited biological evidence. It has been well established that DNA profiles obtained from degraded samples are often of limited value due to the frequent occurrence of preferential amplification during polymerase chain reaction (PCR). The by-products of preferential PCR amplification are often observed as inter- and intra-locus peak imbalance, allelic dropout, and/or locus dropout. Inspired by advances in next-generation sequencing techniques, we propose a methodology for simultaneously normalizing the abundance of PCR products across all short tandem repeat (STR) loci using the DNA exonuclease, duplex-specific nuclease (DSN). DSN is an enzyme isolated from the hepatopancreas of Red King (Kamchatka) crab that possesses a strong affinity for digesting double stranded DNA (dsDNA). Degraded DNA known to display peak imbalance and allele dropout was amplified using AmpFISTR® Identifiler® Plus for 28 cycles. Following amplification, samples were denatured at 99.9 °C for 5 min and incubated with one unit of DSN at 62 °C in a 28 µl volume for 1 min. Nuclease activity was terminated through the addition of equal volume of 10 mM EDTA and 95 °C incubation for 2 min. The findings obtained support the potential use of DSN treatment as a method for normalizing STR profiles.

05.10.03 A Validation Study of the Bloodstain Classification Decision Map

Kacey, Brown , Craig Gravel, Mark McCoy, Tracy MorrisWayne Lord

University of Central Oklahoma

Currently, there is no globally-accepted set of standards to back up a conclusion for a bloodstain classification at a crime scene. This study seeks to assess the Bloodstain Classification Decision Map, created by Bevel Gardner and Associates as a teaching tool, through a validation study involving current law enforcement and crime scene personnel. This could be especially beneficial to the discipline in courts of law, providing a basis to support expert testimony, along with helping crime scene personnel classify bloodstains in the field, to better determine the potential valuable of evidence. The researcher will photograph 15 types of bloodstains that were created by an expert in the discipline of bloodstain pattern analysis. Fifty participants in law enforcement and crime scene investigation will be sent 14 bloodstains to classify. Twenty-five will be given the Bloodstain Classification Decision Map along with their stains, and will be told to follow it as an aid to their bloodstain identification. The other 25 will have no aid, and will be asked simply to use their knowledge base. All 50 participants will have taken at least 40 hours of bloodstain coursework from Bevel Gardner and Associates. Subsequent statistical analysis will be conducted, incorporating sensitivity, specificity and accuracy measures along with T-test calculations and comparisons of how participants with the Decision Map performed compared to those without looking for significant differences.

05.10.04 Comparison and Assessment of Field Test Kits for Commonly Seized Drugs of Abuse

Viena, Thomas , Heather Schafstall, Thomas Jourdan

University of Central Oklahoma

Attendees will learn the differences in various types of field test kits. The capability, advantages and disadvantages of these test kits will be demonstrated. Different kit types will be used to identify marijuana, bath salts and synthetic cannabinoids. This presentation will impact the law enforcement and forensic community by providing an unbiased comparison and analysis of presumptive field test kits; in order to make an educated decision about which kits best meet their needs. Comparisons and assessments included the ease of use, number of compounds presumptively identified by a kit, and accuracy of identification. Synthetic compounds are continuously changing with time and legislation. With these changes, law enforcement must identify which packages of synthetic cannabinoids are controlled and decide whether or not to seize the drug. Field test kits were used to determine if new synthetic cannabinoids are able to produce accurate results with present kits. Confirmatory identification for all samples analyzed were done using a gas-chromatograph/mass spectrometer. Three commercially-available marijuana test kits were compared for their thermal stability via intermittent testing during storage at temperatures of -20oF and 120oF for a period of six weeks. Kits containing Duquenois-Levine reagent showed stability under these temperature regimes. Synthetic compounds with similar base structures are observed to react positively with the reagent of the kits.

05.10.05 Practical Evidence Processing: Does Cyanoacrylate Fuming Hinder Firearms Analysis?

Elyse, Owens

University of Central Oklahoma

Cyanoacrylate fuming is a successful and efficient chemical process of revealing latent prints on non-porous objects found at crime scenes. In a crime laboratory setting, firearms may be processed for latent prints. While firearms are fumed, little research has been conducted to determine if this process hinders the firearm analysis information it may provide. The lack of research on this subject may lead to potential misinterpretations as to what precautions should be taken prior to the latent print examination, and may lead to the loss of potentially vital evidence. The purpose of this study is to discover whether cyanoacrylate fuming masks critical areas within firearms that may contribute to an identification. Comparing firearm components before and after the fuming process can provide valuable information that may prove useful when processing fingerprint evidence on firearms. This study may be beneficial for labs conducting both firearm and fingerprint analyses by demonstrating that covering critical areas in a firearm does or does not hinder evidence that may be gathered from the firearm analysis process. If examiners knew how the fuming process affects firearm information, appropriate corrective measures could be used to ensure the maximum amount of evidence is discovered.

05.10.06 A Comparative Study of CAD Zone and SceneVision 3D Software Programs for Creating 3D Models for Crime Scene Reconstruction

Robyn, Mihandoost

University of Central Oklahoma

CAD Zone and SceneVision 3D are both fairly new software programs that can use acquisitioned data from the Faro Focus 3D laser scanner to create 3D models of crime scenes for the purpose of crime scene reconstruction. These two software programs have yet to be compared with each other. This research study will involve scanning a mock crime scene using the Focus 3D. Using this scanned data, a comparative study of these two software programs will be undertaken. Analysis will be performed concerning the difficulty of using the software, the time it takes to create a model, the pricing of the software, and which software program creates the most useful and accurate 3D model. This comparative study will assist law enforcement agencies in evaluating the hardware and software which best suits their department, and will assist the manufacturers in improving their product.

05.10.07 Assessing DNA Quantity and Quality Using Real-Time PCR

Danielle, Rose

University of Central Oklahoma

Since DNA analysis techniques were first utilized for forensic science purposes, vast improvements have been made in the fields of forensic science and the analysis of biological evidence. With the introduction of the current methods of DNA analysis, it is now possible to identify the donor of a biological sample to the exclusion of all others. Short tandem repeat (STR) analysis, the current DNA analysis method, however, can be susceptible to severe DNA degradation to the point where a full DNA profile cannot be determined. Although there are several proposed methods to analyze degraded DNA samples, a technique to determine the extent to which a sample of DNA is degraded would be beneficial to the forensic science community by saving time and money, both of which are extremely limited in forensic laboratories. One method with which to do this would be through the use of DNA quantification methods, specifically real-time PCR. Several techniques to do this are available, but most lack the validation studies needed in order to be used for forensic purposes. A new methodology is proposed that will utilize real-time PCR to assess both the quantity and quality of DNA present in a biological sample.

05.10.08 Patterns of Cooling-off Periods in Serial Homicide Cases

Mia, Solomon , John Mabry

University of Central Oklahoma

Although the term is well defined, little information is available about patterns, length, or specificity with respect to the cooling-off period in serial homicide cases - specifically pertaining to the offenders' individually unique patterns. We hypothesize that there is a relationship between cooling-off period and other patterns of kill that might assist law enforcement in earlier identification of serial homicide offenders. To determine whether patterns can be predicted, we will assess the relationship between the length and patterns of the offender's cooling-off period to other well characterized patterns in serial homicide cases. The proposed research will examine the available published information about serial homicide offenders, victims, and cases in conjunction with data obtained from the serial killer information center database created by Dr. Robert Aamodt and his students' at Radford University. For the proposed study, a serial homicide offender will be operationally defined as one who kills three or more victims, during three or more separate events, at three or more locations (Campbell & DeNivi, 2004) and the cooling-off period will be defined as the time between when an offender stops killing, and returns to his or her traditional way of life between killings, whether for personal reasons or viability reasons (Douglass et al., 2006).