

Biology Posters

(P21) Impacts of Desiccants on DNA Quantity and Quality in Sexual Assault Kits Over One Year

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Finding the ideal collection and storage process is crucial to maintaining the quality and quantity of DNA. A desiccant-based collection kit, manufactured by Gentueri, and a non-desiccant-based collection kit, used by the Pennsylvania State Police, were used to make contrived sexual assault samples. The sexual assault samples were stored for up to 12 months, at room temperature and 4 °C to determine which kit better preserved the quantity and quality of DNA in the samples. The results indicated that there were no noticeable differences between the two kits between months 4 through 6. In month 7 when the Gentueri Sexual Assault Kit appeared to perform better than the Pennsylvania State Sexual Assault Kit. There were no noticeable differences between the different storage temperatures. The study could be expanded to different states with different climates to achieve a more standardized procedure for collecting sexual assault kits across the United States.

(P23) The Effects of Thermal Stress on the Structure and Downstream DNA Analysis of Human Teeth

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Human identification cases stemming from natural disasters, terrorist attacks, fires, and car accidents often use recovered teeth as a viable source of DNA. However, sufficient DNA from a tooth may be a challenge to obtain if they are exposed to extreme heat, especially for an extended time period. This study demonstrates that the DNA quality is compromised under thermal stress. For this project, forty-four human wisdom teeth were collected following extraction an oral surgeon between 2019 - 2020. This study used two male and two female individual wisdom teeth at each extreme temperature, 500°C, 700°C, and 900°C. DNA was analyzed by quantification, amplification, and ran on a CE. Profiles were created and allele locus dropout, peak height ratio (PHR), and degradation values were determined. Overall, this study advances the knowledge on heat transfer and the ability to extract DNA from human teeth exposed to thermal stress.

(P6) Comparison of DNA Extraction Methods

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Three forms of DNA extraction types include solution-based, column-based, and magnetic bead-based methodologies, with the latter being the accepted methodology used in forensic laboratories. Magnetic bead-based DNA extraction uses the negative charge of DNA and the positive charge of the magnetic beads to isolate the DNA strands and produce a purified sample. However, solution and column-based extraction methods use the same techniques of washing to purify DNA and typically have comparable DNA yields. Cheek swabs were obtained from ten individuals and the three extraction methods were performed to determine the quantitation of double-stranded DNA and the quality of the gel electrophoresis profile. Preliminary results indicate that solution-based extraction produces a slightly higher yield of double-stranded DNA having a 3.92% difference between the average quantitation of 26.29 ng/μL from solution-based and 25.28 ng/μL from magnetic bead-based methods. However, it is expected that the magnetic bead-based extraction will produce higher quality gel electrophoresis results. Overall, the methods examined produced similar DNA extraction efficiencies. This research was made possible by NASA West Virginia Space Grant Consortium, Training Grant #80NSSC20M0055 and the STaR Sure Grant.

(P15) Evaluation of EuroForMix as a Tool for Mixture Interpretation

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EuroForMix, an open-source continuous mixture interpretation software, was assessed for its accuracy of the deconvolution and likelihood ratio functions. A portfolio of 40 mixtures used for this assessment contained combinations of high quality and degraded DNA from buccal and/or blood samples, and ranged from two to four people. DNA mixtures were amplified using the AmpFISTR® Identifiler® Plus PCR Amplification Kit (0.75ng input), detected on a 3500 Genetic Analyzer, and analyzed using GeneMapper ID-X v1.6 with analysis thresholds of ranging from 75RFU to 150RFU (with and without stutter filters). Strengths and weaknesses of EuroForMix as a tool for mixture deconvolution and likelihood ratios will be discussed.

(P18) Examining the Presence of Foreign DNA on Neck Swabs

Alexa Gonzalez Morales, L. Kathleen Sekula, PhD, and Lyndsie Ferrara, PhD - Duquesne University*

Growing research suggests the increase of strangulation in sexual assault cases. In suspected strangulation cases, it may be possible to retrieve touch DNA from a survivor's neck and detect the DNA profile of the perpetrator. However, it is imperative to first establish if foreign DNA is present on an individual's neck even without a strangulation event. This study looks to determine the presence of foreign DNA on a subject's neck after exposure to everyday activities. Reference and neck swabs were obtained from numerous volunteers and these were compared to determine the presence of foreign DNA.

(P22) Assessing adventitious matches of non-donors related to true contributors & the impact of number of contributors (NOC) assessments for DNA mixtures

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Assigning the number of contributors (NOC) to DNA mixtures can be a challenging aspect of mixture interpretation leading to variability amongst analysts. This difficulty can be exacerbated as the true NOC increases or as the degree of allele sharing between donors increases (e.g., related individuals). Additionally, as the number of related individuals within a mixture increases, so does the potential for adventitious matches of related non-donors to the mixture. Therefore, the extent to which related non-donors result in adventitious matches will be assessed as well as the reliability of software solutions such as FaSTR and NOCIt in assigning NOC determinations.

(P8) DAPI Nuclear Hair Root Staining for STR Typing

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The DNA binding dye 4', 6-diamidino-2-phenylindole (DAPI) has been shown to be an efficient and cost-effective method for screening hair roots for the presence of visible nuclei. In this study, 183 hair samples were collected and microscopically examined by a qualified Forensic Trace Examiner for their suitability to be routed for nuclear DNA or mitochondrial DNA analysis. The hairs samples were DAPI-stained and further classified into five bins based on the number of visible nuclei detected in hair roots: bin 1 (0 nuclei), bin 2 (1 – 24 nuclei), bin 3 (25 – 49 nuclei), bin 4 (50 – 99 nuclei) and bin 5 (> 100 nuclei). The bins were used to determine the minimum number of hair root nuclei required to yield an STR profile suitable for National DNA Index System (NDIS) upload. Results from this study showed that DNA yield positively correlated with the number of nuclei. In addition, a threshold was identified such that hair samples containing at least 25 visible nuclei could produce STR profiles that are suitable for NDIS upload.

(P3) Identifying the Presence of Semen Through the Detection of Fructose

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Seminal fluid is among the most valuable sources of biological evidence which can be recovered from a crime scene. Current testing methods for seminal fluid, such as the prostate-specific antigen (PSA) test and microscopic examination for spermatozoa, are non-comprehensive and have a high potential for false positive or false negative results. Fructose is a naturally occurring sugar found in high abundance in semen; therefore, quantification of fructose in biological samples may aid in the identification of seminal fluid, forming an alternative method to PSA testing. We developed an optimized version of the colorimetric resorcinol method for fructose quantification. This method was then tested on normospermic and vasectomized seminal fluid samples and various other bodily fluids to determine fructose concentrations in these samples and evaluate the feasibility of this novel identification method for forensic applications.

(P9) A Comparison of DNA Yield from Cotton and Nylon Swabs in Simulated Sexual Assault Samples

Sylvia Hamilton, B.A.; Elizabeth Wisbon, M.S.; Lindsey Campany, M.S.; Pamela Marshall, Ph.D. - Duquesne University*

Sexual Assault Kit (SAK) collection is the process of collecting biological evidence from victims for use in the prosecution of a sexual assault. Since the inception of SAKs in the 1970s, cotton swabs have been the predominant collection device utilized despite their tendency to embed DNA within the fiber matrix. In this study, two swabs were evaluated for their ability to release DNA: the traditional cotton swab, and the Copan® 4N6FLOQSwabs which have nylon fibers that purportedly rapidly release DNA. A differential extraction was performed on simulated samples of donated vaginal swabs treated with diluted semen using the Promega Differex™ and DNA IQ™ Systems with quantification performed using the Quantifiler™ Trio kit. The findings demonstrated a statistically significant increase in DNA concentration retrieved from nylon swabs which has direct implications for forensic nursing, increasing robust prosecutions and improving outcomes for survivors of sexual assault.

(P11) The Recovery of Human DNA in an Aqueous Environment Using Novel Technology

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This research intends to implement a novel method of human detection in aqueous environments to assist in missing persons cases. During this study, a tissue sample was submerged at a depth of 3 ft in a pond located in Kane, PA; tissue was also placed within a control chamber to understand the impact of environmental conditions. Water samples were collected at 0 ft, 3 ft, 6 ft, 9 ft, and 12 ft from the tissue sources every week for two months. A novel Microbubble technology from Akadeum Life Sciences was used to extract the DNA from the collected water samples. Samples were quantified and the highest quality and least degraded samples were amplified and genotyped. Overall low quantities of DNA were recovered, but the Microbubble extraction kit yielded some partial DNA profiles. Continued research regarding detection of DNA in water may prove critical in missing persons investigations involving aqueous environments.

Chemistry Posters

(P1) The use of Leaf Spray Ionization Mass Spectrometry for the Detection of Kratom (*Mitragyna speciosa*) Leaf

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Mitragyna speciosa is a plant that produces a metabolite called mitragynine and recently it has become available in the United States and is commonly known as kratom. Kratom is currently not considered an illegal substance in the United States; however, the Drug Enforcement Administration has deemed it a drug of concern. The purpose of this study is to detect *Mitragyna speciosa* using Leaf spray Ionization Mass Spectroscopy (LSI-MS), this was proven to be successful. Three strains tested, meng da, red meng da, and white meng da and all contained a parent ion peak at 399 m/z which is indicative of the [M+H]⁺ peak of kratom as it has a molecular weight of 398.5 g/mol. The fragment ion peaks that were present in the CID scans of 399 were 364m/z, 238m/z, 226m/z, and 174m/z. From these results, the hypothesis stands that kratom can be detected using LSI-MS.

(P10) The Development of the Expert Algorithm for Substance Identification (EASI) for n-Alkanes

Alexander Pfeffer - West Virginia University

Gas chromatography-electron ionization-mass spectrometry (GC-EI-MS) is considered one of the gold standard methods of analysis to help identify seized drugs, trace evidence, and ignitable liquid residues. Forensic chemists often use computer algorithms to assist with mass spectral matching of questioned spectra to reference spectra in a database, but most mass spectral algorithms struggle to differentiate between compounds with very similar EI-mass spectra, like the larger n-alkanes. Here, we demonstrate the effectiveness for a new algorithm, called the Expert Algorithm for Substance Identification (EASI), which, instead of comparing one query and one reference spectrum to one another, assesses how well the query spectrum matches a pattern of behavior of replicate reference spectra. For a series of challenging tasks, like differentiating large n-alkanes from one another, EASI identified n-alkanes with error rates less than 3%, whereas conventional algorithms had an error rate greater than 20%. Therefore, EASI can help analysts identify unknown substances more accurately and with more confidence than existing algorithms.

(P7) Analysis of the Transfer of Drugs to the Envelope in Mail Over Time and Varying Conditions

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As the drug abuse epidemic continues, more individuals who suffer from substance abuse disorders are ending up in the prison system, and more drugs are being smuggled into prisons. A common smuggling method is the "soak" method, where pieces of paper are soaked in a solution containing illicit substances, placed in envelopes, and sent to the prison as mail. Using surrogate drugs, this research aimed to determine how much substance transfers from the substance-soaked paper to the envelope. White computer paper was dipped in a 3.33 mg/mL solution of the substance dissolved in rubbing alcohol, placed in either white or manila envelopes and then allowed to sit for varying time frames or sent in the mail, before being analyzed using gas-chromatography mass-spectrometry. Results have shown that the short-term samples had the highest transfer, and white envelopes had more transfer than manila envelopes.

(P2) Analysis of Drug Content Distribution on Paper using both Soak and Spray Methods by Gas Chromatography-Mass Spectrometry (GC-MS)

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In recent years, illicit substances have been increasingly smuggled into prison systems, which pose risks to any individual coming into contact with the mail. Despite this issue growing, little research has been completed, so this study aims to investigate the distribution of drugs on paper while observing both soak and spray methods. For this research, a 3.33 mg/mL solution was created by dissolving the drug in acetone and each paper was either soaked or sprayed with the solution. After extraction, Gas Chromatography-Mass Spectrometry was used to analyze samples to observe the distribution of the surrogate drug on paper. Results show that drug concentration tends to increase along the edges of the paper and that there was a statistically significant difference between both soak and spray methods; by understanding how drugs are distributed on paper, further research can be conducted to help identify when a piece of mail has been tampered with.

(P13) Identification and Quantification of Illicit Drugs in Blood Using Stir Bar Sorptive Extraction and LC-QQQ-MS

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The danger proposed by illicit drug use has led to further research into more sensitive substance detection and identification techniques for biological samples. In this study, polydimethylsiloxane-coated magnetic stir bars were used to extract analytes correlating to a fifteen-drug panel from blood samples. The drug panel included illicit substances such as fentanyl and heroin and medical prescriptions like oxycodone and methadone. LC-QQQ-MS with a biphenyl column was used for separation and quantification of these analytes. There have been promising results that the addition of salts has aided the extraction process by making the PDMS more favorable for the drug analytes.

(P19) Detection of Low Concentration Ignitable Liquid Residues from Fire Debris Using Gas Chromatography-Mass Spectrometry and an Ignitable Liquid Detection Canine

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Detection of ignitable liquid residues (ILRs) at a fire scene can indicate criminal activity and aid investigators in the classification of a fire. Ignitable liquid detection canines (ILDCs) are commonly used to assist in detecting potential remains of ILRs and direct investigators to notable locations for sample collection. There have been instances where gas chromatography-mass spectrometry (GC-MS) has been unable to confirm the presence of ILRs after an ILDC has alerted. In this study, twenty-seven samples of wood and carpet containing different volumes of gasoline were burned for varying periods of time, and subsequent ILDC and GC-MS analyses were performed and compared. Overall, while the limits of detection for gasoline between these two methods were unable to be determined, the majority of test samples showed consistencies between ILDC alerts and GC-MS results; therefore, this research can spearhead further studies and may aid fire investigations by enhancing the analysis of fire debris.

(P14) ELISA Detection of Drugs of Abuse in Hair Samples Using a Modified Extraction Method

Hayden Heche - Ohio Northern University

Forensic toxicological analysis of 15 known positive hair samples, analyzed in two aliquots, using ELISA Hair-Drug screening and solid-liquid extraction techniques. For primary aliquots, ELISA detection was performed for THC, Methamphetamine, Amphetamine, Cocaine, Opiate, and Oxycodone assays. LC/MS/MS and GC/MS/MS methods were used to analyze secondary aliquots. Results quantify the presence of Methamphetamine, Amphetamine, Cocaine, and Carboxy-THC.

Physical Evidence

(P16) "We Bury the Pig. You Do the Dig!" Scenario Based Training for Law Enforcement

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The increasing number of law enforcement requests for assistance in the identification, documentation, and exhumation of clandestine graves associated with MS13 gang violence has underscored the need for archaeological training in the forensic sciences. Over the past decade, Towson University anthropology faculty have worked to equip police investigators with fundamental archaeological skills through a robust, multi-day classroom and scenario-based field training program. This paper traces the development of this program from its modest inception to a traveling course that is designed to reach the maximum number of law enforcement participants.

(P5) Assessing fentanyl concentrations in forensically relevant blow fly (Diptera: Calliphoridae) larvae to improve minimum postmortem interval estimations

Shelby Hale - Duquesne University

Forensic entomotoxicology is a subfield of forensic investigation involving analysis of illicit substances in entomological specimens. Illicit drugs can alter carrion insect growth, which could decrease minimum postmortem interval (mPMI) estimation accuracy with entomological evidence. This study aimed to identify how fentanyl concentrations in human tissues affected blow fly (Diptera: Calliphoridae) larvae development. Fentanyl was distributed within cadaveric tissue and offered to larvae, in vivo measurements were taken, and larvae were euthanized after reaching the third instar stage of development. Following homogenization, larval samples were subjected to solid-phase extraction, and the eluent was analyzed as an alternative toxicological matrix using liquid chromatography triple quadrupole mass spectrometry.

(P20) The Significance of 3D Printed Firearms with Regards to Lethal Capacities and Traceable Elements

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Metal detectors, gun-shot residue (GSR), serial numbers, and other commonly used firearm analysis methods have proven to be no match for 3D printed ghost guns in preliminary results. Three Liberator model guns were produced for this testing utilizing two polymers in the 3D printing process: acrylonitrile butadiene styrene (ABS) and polylactic acid (PLA). A remote trigger-device was used to fire the assembled weapons directly into a contained system to assess their lethality in humans. Gun remnants present at the conclusion of the firing process were collected for analysis including determination of structural integrity. This research advances knowledge and understanding of 3D printed firearm analysis.

(P4) The Impact of Age on Strength and Fracture Patterns of the Human Hyoid Bone

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Fractures of the hyoid bone are significant indicators of trauma to the neck, causing them to garner great importance and relevance in the forensic science community. In this study, four digital imaging files (.stl) of female hyoid bones were collected for each age group of 18-30, 30-45, and 45-80 years old. A Bambu Lab X1 3D printer was used to create four copies of each hyoid bone, and several morphological measurements were made before encasing the forty-eight bone models in gelatin and chamois. A Torbal Odyssey force gauge was utilized to determine the amount of force necessary to produce fracture and the location of fracture in a simulation of manual strangulation. The data suggests that there is no trend in force as age increases and that the location of fracture is nonrandom.

(P12) Fingerprint Correlation Between Identical Twins

Cody Barnes - Fairmount State University

When teaching about the uniqueness of fingerprints it is commonly said that identical twin fingerprint characteristics are not identical however, limited research has been conducted to determine if there are any correlations between similar print characteristics. In the recent past unrelated individuals have been misidentified based on fingerprint similarities in forensics cases and this may be more likely among twins. This research case study's objective is to determine if there are any correlations between fingerprint characteristics of identical twins and the probability of misidentification. Identical twin fingerprints were collected onto 10 print cards and blindly analyzed. Preliminary results indicate a strong relationship between characteristics, but it is not significant (0.49; $p = 0.35$); fingerprint characteristics between hands were not significantly different (R: $p = 0.75$, L: $p = 0.24$). Results indicate there could be a possibility of misidentification, but more twin fingerprints should be analyzed.

(P17) Conducting A Psychiatric Analysis using Collateral Materials: A Case Study of Theodore Kaczynski

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Competency to stand trial and sentencing are both factors impacted by the results of a mental health evaluation. Currently, these evaluations utilize interviews with the defendant to answer the question of their mental state. In cases of Fifth Amendment invocations, these individuals do not have to speak with the mental health expert and a method of analysis that does not require the interview becomes necessary. A case study of Theodore Kaczynski has been used to develop such a method, specifically with documents. These documents are being compared to the diagnostic criteria found in the DSM-5 (2013) as well as the PDM-2 (2008) to determine if a potential diagnosis can be reached. This research will impact the forensic science and legal community by presenting a method to assess mental health disorders when an individual invokes their Fifth Amendment rights and refuses to participate in psychological evaluations.