A63 Extraction, Quantification, and Analysis of DNA From Spent Shell Casings

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After attending this presentation, attendees will be educated about obtaining DNA profiles from the most commonly used spent bullet casings. Attendees will also learn about a modified mini - STR plex that will be used to identify the bullet casing DNA against a reference sample.

This presentation will impact the forensic community by: (1) demonstrating that DNA is not destroyed in the firing process (as commonly perceived), (2) examining the loading order of the bullets in relation to the deposition of touch DNA on the bullet casings, and (3) further establishing the utility of the mini - STR panels in forensic casework.

According to the FBI[1] in 2006, 29.3% of all murders, robberies, and aggravated assaults were committed with a firearm. Usually, when detectives arrive on the scene, the only evidence related to the gun used is spent shell casings. Frequently, spent shell casings or unfired rounds are sent to crime laboratories for fingerprinting with limited, if any successful results. While loading the magazine of a handgun, DNA is deposited on the bullet via the shedding of the epithelial cells. Several studies involving Transfer DNA have shown that a held object can readily yield Low Copy Number (LCN) DNA. Thus, the forceful contact required to load a handgun magazine can easily lead to the shedding of epithelial cells and LCN DNA.

It has previously been thought that the heat generated by the firing of a handgun degraded or destroyed the LCN DNA left on a shell casing. In a companion study, the temperatures inside the chamber of a gun of which the shell casing and DNA are exposed were analyzed. Past research has shown that it is possible to recover partial and full profiles from spent shell casings using a miniplex.[2] The research to be presented will utilize a miniplex developed at Duquesne University to aid in LCN DNA research. The loci used include D8S1179, D16S539, D5S818, D3S1358, and amelogenin.

Subjects involved in the present study were asked to load a Glock 9mm magazine with ten bullets. After loading, each subject fired the entire magazine under the control of former Pittsburgh Police Major Crimes Unit Commander Ronald Freeman. The shell casing was collected post ejection via autoclaved wooden toothpicks and placed in a paper bag. Each bullet casing was assigned a random number by an individual not involved in the study, thus creating a study blind. Reference samples were taken at a later date, via buccal samples and were similarly assigned a random number. At no point in the study were the research subjects directly identified or linked to their coded identification number.

The experimental design involved ten study subjects, seven males and three females. The skewed sex ratio was determined based on the number of handgun crimes committed by each sex according to the most recent crime statistics for the City of Pittsburgh based on charges for VUFA (Violation of the Uniform Firearms Act). Of these 301 charges that occurred during the time period between 1/08 and 6/08, 96% of the violations were committed by males. The most commonly used handgun was a 9mm, which is consistent with the national rankings (per.comm. Ronald Freeman). Locally, of the 301 charges of VUFA, 28% were for 9mm handguns. Similarly, the use of Federal brand ammunition in this study was determined with the assistance from Pittsburgh Mobile Crime totaling up to 21% of the recovered casings.

DNA from the individual shell casings were transferred using a modified double swabbing technique that used a 50% ethanol solution as a surfactant. The swabbing tops were cut and placed in a 1X PBS solution. DNA was extracted using a modified buccal swab protocol from the commercially available Qiagen QIAamp DNA Blood Mini Kit. Samples were quantified via real-time PCR. Multiplex PCR was performed on the samples and utilized approximately 100ng of DNA. Genotyping was performed on an ABI 3100-Avant Genetic Analyzer. Preliminarily results support all three aims identified in this study.

References:

1 United States. FBI. Crime in the United States. 25 Jan. 2008. 22 July 2008 <http://www.ojp.usdoj.gov/bjs/glance/tables/guncrimetab.htm>.

2 Horsman-Hall, Katie M., Stephanie L. Karczynski, Yvette Orihuela, Ann L. Davis, Susan A.-Greenspoon, and Jeffrey D. Ban. Developing STR Profiles From Fired Cartridge Cases Using the AmpFℓSTR® MiniFiler™ PCR Amplification Kit. Virginia Department of Forensic Science. Applied Biosystems, 2008. Feb. 2008 <http://marketing.appliedbiosystems.com/images/All_Newsletters/Forensic_Vol13/docs/53144_FN_Customer_Corner_b.pdf>.

LCN DNA, miniSTRs, Shell Casings