B9 An Improved Swabbing Method for the Collection of DNA From Fired Cartridge Cases

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Learning Overview: After this presentation, attendees will be informed of the methods evaluated at the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) Laboratory to improve DNA recovery from fired cartridge cases. This presentation suggests a variation on the traditional double swab method to increase DNA recovery from brass/copper cartridge cases.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by increasing awareness of the potential DNA evidence on fired cartridge cases and provide justification for a new collection method that can be implemented into an existing workflow without interfering with downstream examination by other disciplines (such as tool mark examination).

Items that have been handled or manipulated, such as cartridge cases, can provide a source of touch DNA evidence that can be critical to forensic investigations. Generation of informative DNA profiles from fired cartridge cases, particularly those containing copper/brass, can be problematic due to the low level of DNA deposition, degradation introduced during the act of firing, and/or the potential for oxidative damage to nucleic acids from the substrate.[1] Methods designed to maximize the recovery of high-quality DNA from these evidence types may increase the success of obtaining probative DNA information. To this end, several aspects of the DNA collection process were investigated for their contribution to improved recovery and preservation of DNA quality from fired cartridge cases in this study. DNA yield was addressed by evaluating multiple swab types; oxidative damage was addressed by incorporating copper-binding additives into the swabbing solution. Additionally, the interval between deposition and DNA collection was reduced to optimize the DNA recovery. Brass 9mm cartridges were handled by volunteers for 30 seconds and loaded into an ammunition magazine, fired at a testing range, and processed for DNA collection. Samples were collected utilizing the double swab technique (wet/dry) with either sterile water or with a swabbing solution that contained bovine serum albumin (BSA) and a copper-binding tripeptide (glycyl glycyl histidine). DNA recovery was also compared when DNA collection was performed using foam popule swabs instead of cotton swabs. After DNA collection with the described methods, all samples were processed through extraction, quantitation, amplification, and typing according to ATF standard operating procedures. Quantitation results and profile peak heights/quality were assessed and compared between methods.

Use of a BSA/tripeptide swabbing solution resulted in an increase in both DNA recovery and quality as evidenced by both quantitation and electropherogram data. However, when the tripeptide solution was spiked directly into an extraction preparation to evaluate possible effects on downstream processes, DNA yield was significantly reduced, indicating a potential negative effect of the tripeptide that requires further study. The foam popule swabs recovered more DNA from the cartridge cases than traditional cotton swabs. However, foreign background DNA was detected on a subset of new unused foam popule swabs. Initial investigation indicates that a reduction in the time intervals between deposition, collection, and extraction may be another potential contributing factor to DNA recovery success observed across all methods tested thus far and will be further evaluated. Overall, the results in this study show that when the BSA/tripeptide swabbing solution was used in conjunction with foam popule swabs, 6/11 (>50%) of the fired cartridge cases yielded more than 75% of the alleles of the individual that loaded the ammunition magazine and 8/11 (>70%) of the fired cartridge cases yielded more than 50% of the loader alleles.

Fired cartridge case evidence is a valuable source of informative DNA profiles and should not be viewed as a “last resort” or a “lost cause” by scientific investigators. As more powerful methods become available, forensic laboratories can and should be positioned to accept fired cartridge case evidence routinely in a manner that is not overly burdensome on existing workflow and provides pertinent information to the criminal justice community.[2-5]

Reference(s):

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Touch DNA, Cartridge Cases, DNA Recovery