B108 Optimized Methods for Collection and Extraction of DNA From Archived Latent Fingerprints

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After attending this presentation, attendees will understand the link between crime scene collection, visualization methods for latent fingerprints, and the success of laboratory analysis. The objective is to identify the best combination of DNA collection, extraction, and typing methods for treated and untreated latent fingerprints that were tape-lifted, secured on paper backing cards, and stored at room temperature for varying time periods.

This presentation will impact the forensic science community by providing more efficient collection and DNA extraction pairings, which are ready for immediate implementation, and by improving the success rate for obtaining probative Short Tandem Repeat (STR) profiles from tape-lifted archived fingerprints. Currently, the forensic DNA literature has not addressed this specific type of challenged sample.

Touch DNA samples have grown since the late 1990s due to advanced forensic technology, giving the potential to provide probative evidence for criminal casework, even in the absence of body fluids. Several studies have evaluated the best collection methods for latent fingerprints when DNA profiling is anticipated; others have separately reported DNA success from adhesives and from paper material. However, there is limited information on best practices for retrieving DNA from latent fingerprints sandwiched between adhesive and paper substrates.[1] Since these samples are often stored for long time periods, likely contain low template DNA, and end in failed analysis or lead to irresolvable mixtures, they are often overlooked as viable DNA evidence. Unfortunately, for many older cases, archived latent fingerprints collected in this manner may be the only physical or biological evidence available. With touch DNA consisting of corneocytes (dead skin cells) mixed with sweat and body oil, the potential for successful typing is high for these archived samples; however, data on success rates, optimized methods, and mixture prevalence is needed before laboratories agree to routinely process these samples.[2,3]

In this study, ten participants provided a set of latent fingerprints on both non-porous (glass) and porous (paper) surfaces. Fingerprints were treated with traditional powders for visualization, tape-lifted, and secured on paper substrates. Initially, single fingerprint cuttings were obtained and DNA recovery was assessed using four extraction methods (phenol-chloroform organic extraction, Qiagen QIAamp® Investigator kit, Invisorb® Spin Forensic kit, and ZyGEM® prepGEM™ Tissue kit). These findings confirmed that human cells (and thus, DNA) are retained on both the adhesive and paper sides of archived fingerprints. The paper substrate held more than three times as much DNA as the adhesive side. Thus, both the paper and adhesive sides should be processed in a combined procedure to improve DNA yields. Overall, the Investigator kit provided more detectable DNA than the other methods (53% of all samples tested). Respectively, DNA from the Invisorb® kit, ZyGEM® kit, and organic extraction provided detectable DNA from 43%, 23%, and 10% of all samples tested. Of the samples detected during quantitation, those processed with the Investigator kit provided the most consistent total DNA yields (1.643ng average); however, when visualization techniques were considered, results varied among the fingerprint treatments: magnetic treated, black carbon powder treated, and untreated fingerprints provided the highest DNA yield with the Investigator kit (2.00446ng average), organic extraction (0.6024ng average), and ZyGEM® kit (0.68322ng average), respectively. Thus, the visualizing technique performed at the crime scene may dictate which extraction will perform most efficiently when preparing archived fingerprints for DNA analysis. Interestingly, fingerprints processed using magnetic powder or black powder produced more detected samples and more DNA (on average) than untreated fingerprints. Based on this data, the Investigator kit was employed to evaluate the best methods for actually retrieving DNA from the paper and adhesive substrates of archived samples. Cuttings, a single-swab technique, and a double-swab technique were compared using multiple swab diluents (distilled water and 2% sodium dodecyl sulfate). Thus far, the double-swab technique is providing more than three times the DNA on average (0.497ng) than the single-swab technique (0.108ng) using water as the diluent.

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In conclusion, this experiment will provide valuable information for forensic DNA examiners seeking to process archived fingerprints for DNA typing. The recommendations will be readily available for immediate execution to increase the likelihood of obtaining a full STR profile for casework. As such, cold cases with limited physical and biological evidence could be revisited with more confidence and less apprehension about these potentially compromised, low template DNA samples.

Reference(s):

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3. Daly D.J., Murphy., C., McDermott., SD. The transfer of touch DNA from hands to glass fabric and wood. *Forensic Science International: Genetics* 2012; 6 (1): 41-46.

Touch DNA, Archived Fingerprints, DNA Typing