B48 Recovery of Touch DNA: A Comparison of Four Collection Methods on Various Substrates

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Learning Overview: The goal of this presentation is to inform attendees of a variety of touch DNA collection methods used globally and their suitability on porous and non-porous substrates.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a comprehensive comparative analysis of different touch DNA collection methods, with the intention of applying these methods to investigations of forced child labor.

It is well established that when a person comes in contact with an item, epithelial skin cells are transferred from person to surface in varying amounts. Therefore, it can be suggested that victims of forced child labor inadvertently shed their epithelial skin cells onto the items they are manufacturing. These cells can then be recovered from protected interior surfaces where only the person manufacturing the item would have touched. DNA isolated from shed cells is commonly known as touch DNA. Donor age estimation of touch DNA samples is currently being researched using DNA methylation analysis and shows great promise. It is crucial to choose a collection method that optimizes the recovery of as many cells as possible. There are several methods currently employed for touch DNA collection within accredited crime laboratories, including the wet/dry double swab method and the mini-taping method. However, there is no globally accepted standard for recovery from different substrates. An extensive search of published literature revealed the wet/dry double swab method, the sodium dodecyl sulfate (SDS) swab method, and the mini-taping method to produce the most consistently high yields of touch DNA. More recently, a novel gel film was suggested as an ideal method for touch DNA collection, with the added benefit of visualizing the cells microscopically on the gel surface prior to extraction. The aim of this research was to investigate the wet/dry double swab, SDS swab, mini-tape, and gel film methods on a variety of substrates selected to be representative of products manufactured by child laborers.

Following ethical approval from the Institutional Review Board (IRB), with informed written consent, one volunteer was selected to deposit touch DNA on all samples to ensure consistency. Eight substrates were chosen: cotton, denim, felt, polyester, plastic, ceramic tile, wood, and cardboard. For the fabric samples, to mimic the manufacturing process, the volunteer sewed a double seam on each sample using a sewing machine, thus trapping the volunteer's epithelial skin cells in the seams. For the other surfaces, flat 4" x 5" sections were rubbed by the volunteer's hand 5 times with approximately the same force applied each time. All samples were performed in triplicate and included a blank control, thereby resulting in 128 samples. Following deposition, each sample was collected using the four collection methods: wet/dry double swabbing, SDS swabbing (2% SDS solution), mini-taping (Scenesafe FAST™ Pack), and gel film (Gel-Pak®). Collection method consumables were sterilized in a UV Spectrolinker prior to use. After collection, the QIAamp DNA Investigator kit (Qiagen®) was used to extract DNA from samples, following the manufacturer's protocol. All samples were eluted in a final volume of 50 µL. All extracts were stored at -20°C until needed for quantitation. Quantitation was performed using the Qubit 3.0 Fluorometer (ThermoFisher Scientific) using the double stranded (ds) DNA High Sensitivity (HS) assay kit. A representative set of samples was chosen for full DNA profiling to compare to a known reference sample of the volunteer to ensure no contamination occurred.

Varying DNA yields were obtained from all surfaces with each collection method. The wet/dry double swab method yields ranged from 0-2.68 ng/µL. The SDS swab method yields ranged from 0-0.134 ng/µL. The mini-taping yields ranged from 0-.188 ng/µL. The gel film yields ranged from 0-.180 ng/µL. On the fabric samples, the mini-tapes appeared to produce the most consistently high yields of DNA. On the other surfaces, the wet/dry double swab method appeared to produce the most consistently high yields of DNA. The yields obtained with these two methods for the various substrates are sufficient for downstream processing, including DNA profiling and methylation analysis.

The results of this study provide a valuable contribution to the forensic science industry by highlighting optimal touch DNA collection methods for particular surfaces. Additionally, this research contributes to the ongoing efforts for age-estimation of touch DNA samples to combat forced child labor.

Touch DNA, Epithelial Skin Cells, Forced Child Labor