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Forensic Science – Biology, B.S.

"Recovery of touch DNA: a comparison of four collection methods on various substrates"

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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 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; 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 these methods on a variety of substrates selected to be representative of products manufactured by child laborers.

Following approval from the Institutional Review Board, 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. To mimic the manufacturing process, the volunteer sewed a double seam on each fabric 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 five times with approximately the same force each time. Following deposition, the four collection methods were used: wet/dry double swabbing, SDS swabbing (2% SDS solution), mini-taping (Scenesafe FAST™ Pack), and gel film (Gel-Pak®). The QIAamp DNA Investigator kit (Qiagen®) was used to extract DNA from collected samples, following the manufacturer's protocol. All samples were eluted in a final volume of 50 μL. Quantitation was performed using the Qubit 3.0 Fluorometer (ThermoFisher Scientific) using the double stranded (ds) DNA High Sensitivity (HS) assay kit. Varying DNA concentrations were obtained from all surfaces with each collection method. On the fabric samples, the mini-tapes recovered the most consistently high concentrations (0-0.314 ng/uL) of DNA. On the other surfaces, the wet/dry double swab method recovered the most consistently high concentrations (0-2.68 ng/uL) of DNA. These yields obtained 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.