Y5 Enhanced Collection and Recovery of Cellular Material, Coupled With Direct Polymerase Chain Reaction (PCR), From Rough Surfaces for Forensic "Touch DNA"

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Learning Overview: After attending this presentation, attendees will understand that comparing a novel method of collection of trace DNA samples from smooth to rough surfaces and objects with a novel vacuum device, the optimization and testing of different filter matrices (e.g., polyvinylacrylate vs. polycarbonate), and new high-fidelity polymerases to provide more robust and complete DNA profiles, along with comparing and eventually eliminating DNA extraction methods, serve to train the student in the entirety of the traditional DNA workflow. Ultimately, enhancing collection with a vacuum device and forgoing DNA extraction for direct PCR will create a new workflow for adequately processing trace DNA samples.

Impact on the Forensic Science Community: The implementation of the Venturi Vacuum Device (VVD), a simple vacuum technology, into the front-end processes of forensic DNA typing could lead to a reevaluation of standard collection techniques of trace evidence. The VVD and direct PCR will have a positive synergistic effect on downstream processes, providing improved genetic profiles. This device could revolutionize the conventional approach to the collection of challenging forensic samples and the subsequent evaluation of DNA profiles generated and used in criminal casework.

The inclusion of DNA evidence in criminal cases is the gold standard of the contemporary courtroom. Of late, collection of low quantities of cellular material is becoming more common throughout federal and state crime labs that use touch DNA, a class of biological trace evidence that is recovered from the epithelial cells in the sweat and oils on the hands of individuals. However, the challenge remains on how to efficiently collect touch DNA evidence associated with casework ranging from property crimes to sexual assault and murder. The downstream analytical success of such valuable evidence continues to be hampered by inadequacies involved in its collection. The inability of traditional collection matrices—cotton swabs—to adequately pick up, then release cellular material once it has been collected has a direct impact on the success of a useable or full DNA profile. This is especially prevalent with touch DNA of unknown quality and found on rough surfaces where a swab falls apart or cannot easily access a surface to even obtain a sample. Therefore, there is a strong need to enhance the collection of cellular trace evidence from rough surfaces commonly encountered at crime scenes.

This research addresses these inherent collection shortcomings by improving cellular collection and subsequent recovery of DNA, especially from rough surfaces, using a field-portable VVD (patent pending). A VVD creates a vortex of negative pressure by passing compressed air (CO_2) through a narrow section of piping, generating a powerful suction. Attaching a Polycarbonate Filter (PCF) to the VVD apparatus allows for the use of the vacuum and suction processes to collect the cellular material. The VVD will first be tested on mock touch samples placed on stainless steel bars (smooth surface), then rope and brick (rough surfaces) using a known quantity (100 cells) of epithelial cells placed on the surfaces. Second, true touch samples from 100 individuals handling rough objects will be sampled with the optimized protocol. This will be compared to samples collected with traditional cotton swabs, where cotton swabs tend to rip and tear when used on porous and textured surfaces. Once collection issues have been addressed, the next step is to eliminate loss of DNA in downstream processes due to DNA extraction. The DNA loss resulting from multiple extraction steps and tube changes adversely affect the success of recovering enough DNA to generate a robust profile. With that said, the combination of VVD collection and direct PCR, forgoing extraction and quantitation steps, will significantly increase the probability of obtaining probative DNA profiles.

Touch DNA, Trace Evidence, Forensic DNA Typing

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