ENHANCED GENETIC ANALYSIS OF BIO-PARTICLES ISOLATED FROM SINGLE- AND MULTI- SOURCE TOUCH DNA EVIDENCE USING MICRO-VOLUME DNA/RNA PROFILING STRATEGIES

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In forensic casework analysis it is sometimes necessary to obtain genetic profiles from increasingly smaller amounts of biological material left behind by persons involved in criminal offenses. The ability to obtain profiles from trace biological evidence is routinely demonstrated with so-called 'touch DNA evidence' (generally perceived to be the result of DNA obtained from shed skin cells transferred from donor to an object or person during physical contact). Although a genetic profile from trace biological evidence is routinely obtained, the tissue source of the profile is rarely known. This merely perpetuates the 'mystery' of the nature of touch DNA evidence allowing the significance or meaningfulness of genetic profiles obtained from these samples to be challenged. Numerous reports state that the tissue source of origin of touch DNA evidence cannot be determined due to the small amount of biological material present, while many others conclude that the DNA profiles are obtained from shed skin cells as opposed to, say, saliva traces without any scientific basis for this assertion. Proper identification of the biological material present might be crucial to the investigation and prosecution of a criminal offense and a misrepresentation of the nature of the evidence can have undue influence on the perception of the circumstance of the crime.

Current methods for the recovery of trace DNA employ cotton swabs or adhesive tape to sample an area of interest. While of practical utility such a 'blind-swabbing' approach will necessarily co-sample cellular material from the different individuals whose cells are present on the item, even if the individuals' cells are located in geographically distinct locations on the item. Thus some of the DNA mixtures encountered in such touch DNA samples are artificially created by the swabbing itself. Secondly it is not possible to definitively identify whether the DNA profiles originate from skin cells or other epithelial cells due to the lack of appropriate biomarker assays for these cell types.

Here we report an enhanced genetic analysis of individual bio-particles recovered from single- and multi-source touch DNA evidence (e.g. worn clothing items and other household items, touched/handled objects and surfaces, skin/skin mixtures) using micro-volume (3.5-5□l) DNA/RNA profiling strategies. A one-step micro-volume lysis/STR amplification reaction permits the recovery of full or probative STR profiles of the donor of single or few bio-particles. A one-step micro-volume cell lysis/reverse transcription reaction, combined with subsequent RNA analysis using capillary electrophoresis (CE) or high resolution melt analysis (HRM) body fluid identification assays, provides the ability to identify the body fluid origin of individual or few isolated bio-particles. The developed DNA/RNA profiling methods, therefore, provide a comprehensive molecular based approach to the characterization, analysis and

interpretation of trace biological material recovered from touch and contact samples. We also demonstrate the ability to apply the developed micro-volume DNA/RNA profiling strategies to improve the analysis of other epithelial cell types (i.e. vaginal and buccal) to aid in mixture de-convolution.