Studies on low template DNA for forensic human identification

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Every contact leaves a trace' is a mantra familiar to forensic science but all too often this trace is too small to analyse further. It is well-documented that individuals have the ability to transfer their DNA to objects, simply by touch. Cells or cell-free DNA may be transferred to objects in the form of oil or sweat residue contained within the finger mark. This feature may be beneficial in that it can be exploited by forensic investigators attempting to obtain a DNA profile from a touched object at a crime scene. It is well-known in forensic science that fingermark traces possess limited DNA. The flow-on effect of this is that the DNA profiling of fingerprints often yields little or no information that can be used to assist police investigations. For samples such as fingermarks, every effort needs to be made to reduce processes that are wasteful of DNA so that the success rate for DNA profiling is maximised. Standard processing in most forensic labs would involve the sample going through a DNA extraction step, which is known to lose high percentages of DNA. One possible workflow, that removes the DNA extraction step, involves placing the sample directly into the Polymerase Chain Reaction (PCR). This process is called 'direct PCR' and has shown to be successful in other forensic applications where traditional DNA profiling failed.

The current success rate when attempting to generate a DNA profile is 5% – 6% using standard methods. Now, in an article in the November issue of *BioTechniques*, Jennifer Templeton and Adrian Linacre has been able, for the first time, to obtain DNA profiles from finger marks, using direct PCR, after depositing a mark by touching various substrates **(JEL Templeton & A Linacre. DNA profiles from finger marks. *BioTechniques* 57.5 (2014): 259).** In our study, informative DNA profiles were obtained from volunteers depositing fingermarks onto plastic, wood, glass and metal substrates using this direct PCR approach. The donors of the prints were able to be identified in a quicker time-frame than is currently possible using traditional methods that involve DNA extraction. It was found that informative profiles can be generated from fingermarks left by a person only 15 minutes after washing hands. Most importantly, direct PCR reduces the opportunity for contamination by eliminating the multiple tube changes and additional steps required during an extraction. The use of a detergent-based nylon flocked swab was trialled and resulted in improved quality of DNA profiles obtained and results published in the 'Journal of the Forensic Sciences' - "Direct PCR improves the recovery of DNA from various substrates".

Consequently, there is a reduction in the cost of labour and reagents needed to process samples and a high through-put potential for case work exhibits. With the direct PCR approach, we achieved a 66%–74% success rate using DNA isolated from fingermarks for detecting the minimum number of alleles required to meet the standard for upload to the Australian DNA Database, a significant improvement over standard protocols.

Overall the work published shows that direct PCR has a role to play in case work and proves to be reliable, robust and reproducible. Most importantly, in many cases direct PCR is the only way to obtain a DNA profile from a crime scene exhibit. A mock case demonstration highlights that direct PCR can be used on samples subjected to environmental exposure and informative DNA profiles obtained, results were later published in the journal 'Forensic Science International: Genetics Supplement Series' - "DNA profile from fingermarks: a mock case study".