B146 Alternate Proteases and Direct Cell Lysis Methods for the Recovery of Exogenous DNA From Fingernails

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The goal of this presentation is to present data from an evaluation of the efficiency of alternative proteases and direct cell lysis methods in extracting foreign DNA from fingernails.

This presentation will impact the forensic science community by suggesting alternative extraction methods for fingernail samples beyond the use of Proteinase K (PK).

When extracting a fingernail sample, it is possible to recover endogenous Deoxyribonucleic Acid (DNA) of the nail donor from within the nail and from the surface of the nail; similarly, foreign DNA may also be present on and recovered from the nail surface.[1,2] When attempting to recover the latter, fingernail samples present particular problems. Often, the foreign component is masked by the greater mass of nail donor DNA present in and on the nail sample.[3] This masking effect is exacerbated by the use of PK in the DNA extractions, as PK, with an average of 200 cut sites per keratin molecule, is capable of breaking open the keratin matrix of the nail and exposing the nail DNA intercalated in the matrix. Directly extracting nail clippings, in contrast to swabbing or scraping, would further introduce nail DNA when using PK.[4] This present study attempts to compare alternative proteases (ZyGEM® and Acrosolv®) with fewer cut sites than PK and two direct cell lysis methods (IGEPAL® CA-630 and Mawi iSWAB™-ID) with the intent of minimizing recovery of nail DNA from within the nail and thus mitigate the masking effect often seen with fingernail samples.

The endogenous DNA extraction efficiency of each suggested method was compared with QIAGEN® QIAamp® DNA Investigator extraction of hand-washed and/or cleaned nails. In contrast to previously published literature, a comparison of the results between hand-washed and cleaned nails suggests that much of the endogenous DNA recovered from fingernail samples is derived from DNA on the surface rather than from within the nail. QIAamp® extraction with the inclusion of Dithiothreitol (DTT) recovered significantly more DNA (p=0.0088) than the sample protocol without DTT. The IGEPAL® method recovered the least DNA from the nail, whereas the Acrosolv® method recovered more DNA than the QIAamp® protocol without DTT. Recovery was observed with the Mawi iSWAB™-ID buffer, but additional experiments are needed.

Fingernails were also spiked individually with blood, saliva, and semen to assess the recovery of foreign DNA. The extractions of the spiked nail samples demonstrate variability across all samples, owing, to some degree, to inconsistencies of sample preparation. IGEPAL®'s inability to recover complete foreign profiles suggests that the method is not viable for extraction of fingernail samples. Conversely, the ZyGEM®, Acrosolv®, and MAWI extraction methods demonstrate potential as alternative extraction methods for fingernail samples and would benefit from additional experimentation.

Reference(s):

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