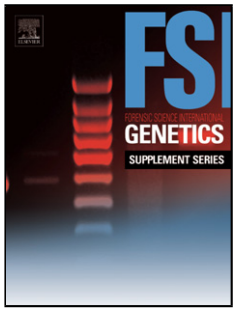

Critical Evaluation of Touch DNA Recovery Methods for Forensic Purposes

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Critical Evaluation of Touch DNA Recovery Methods for Forensic Purposes.

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Abstract

Over the past decade there has been a significant increase in the number of submissions of 'touch DNA' evidence to forensic laboratories. Previous research has indicated that analysis of these samples produces low success rates. Published research, as well as case work review by forensic practitioners, has also indicated more consideration of how to improve the evidential value of 'touch DNA' samples is needed. Therefore, this research aims to critically evaluate low level DNA recovery methods in order to maximise efficiency for forensic identification purposes. Typical evidential items, such as plastic handled screwdrivers, aluminium cans, drinking glasses and wooden handles, were handled in a mock-operational trial. The deposited DNA was recovered from these items using a range of swabbing materials including cotton, polyester and foam. These samples then underwent quantitative PCR analysis and were profiled using AmpFLSTR™ NGM SElect™. The DNA quantity and quality were compared and a statistically significant differences were found to be present between recovery methods with the foam swab recovering more donor alleles overall.

Keywords: Touch DNA, Swab Material, Surface Type

1. Introduction

The number of cases where low level DNA has the potential to be evidentially valuable, and therefore is being analysed, has greatly increased [1]. In particular, 'touch' or 'contact' DNA from individuals and surfaces has become one of the most analysed sample types [2]. The recovery of touch DNA is key to the success of this evidence type. Due to this, it is vital that the correct recovery method is used to maximise the amount of DNA recovered [3,4]. However, the research conducted to date into the optimal recovery method for DNA evidence has generated conflicting results [5-8]. Therefore, this research aims to critically evaluate low level DNA recovery methods in order to maximise efficiency for forensic identification.

2. Materials and Methods

2.1. Sample Preparation and Collection

Mock evidential items consisting of plastic handled screwdrivers (n=32), wooden handles (n=32), drinking glasses (n=32) and aluminium drinks cans (n=32), were purchased for the purposes of this research. These were treated with 2% Virkon, 100% Ethanol and then autoclaved to remove any DNA that might be present. The items were then packaged in evidence bags to be handled by donors (n=4) in order deposit touch DNA.

One hour prior to sample deposition, donors were asked to wash their hands thoroughly and continue with their normal daily activities. The plastic handled screwdrivers and wooden handles

were held in the palm of the donor's hand for 5 minutes and rotated every minute in order to replicate ordinary use. This was repeated once daily for 7 days. The drinking glasses and aluminium drinks cans were drunk from by the donor ensuring contact was made between the donor's hands and the side of the items.

The deposited DNA was recovered using the double swabbing method with sterile water as the moistening agent. Differing swab materials were utilised to asses the impact that the swab material has upon the resulting profiles. The swab materials that were used are as follows; Cotton (Deltalab) (n=32), Foam (Medical Wire) (n=32) and Polyester (Medical Wire) (n=32).

2.2. DNA Analysis

All samples were extracted using QIAmp DNA Micro Kit (QIAGEN, UK) following the 'small volumes of blood protocol. The extracted DNA was then underwent quantitative PCR using the human specific gDNA quantification kit (Primer Design, UK) following the manufacturers protocol in a half reaction mixture and characterised using the Applied Biosystems Step One Plus software. STR analysis was then conducted using NGM SELect following the manufacturers protocol with a half reaction mixture. The samples were then analysed using the Applied Biosystems 3500 Genetic Analyser.

2.3. Data Analysis

Interpretation of the profile data was conducted using the Gene Mapper ID-X software. A Kolmogorov-Smirnov test was carried out to determine if the data was normally distributed followed by a Kruskal-Wallis test to assess the impact that the surface type and swab material has upon the resulting profile. Post-hoc testing was also conducted with a Bonferroni adjustment to the significant level ($p < 0.0083$; $p < 0.0167$) to asses where these differences originated.

3. Results and Discussion

As observed in figure 1 the mean number of donor alleles recovered varies both depending upon the surface the DNA is being recovered from and depending upon the swab material. A significant difference was found between the number of donor alleles recovered from the different surface types ($p=0.008$) and also between the different swab materials ($p=0.031$) with significantly more donor alleles being recovered. Post-hoc testing identified that there were more donor alleles recovered from the wooden handle than the plastic handled screwdriver ($p=0.001$). Post-hoc testing also indicated that the foam swabbing material recovered more donor alleles than polyester ($p=0.014$).

When recovering touch DNA evidence, it is important to ensure the correct recovery method is used [3]. This research indicates that it is not possible to indicate a single recovery method for all samples but that an optimal recovery strategy should be adopted depending upon the surface type. For instance, more donor alleles are recovered from wooden handles with the foam swab whereas more donor alleles are recovered from the plastic handled screwdriver using the polyester swab. From the data produced in this study it can be suggested that when recovering touch DNA from a wooden surface that a foam swabbing substrate should be adopted. However, when recovering this evidence type from a plastic surface a polyester swab is more effective. The nature of the surface in regard to texture and porosity has a great impact upon the successful recovery of this evidence type as with the rough and slightly porous wooden surface the foam swab retained its integrity and recovered more alleles whereas the other swab materials became unwound from the shaft losing their integrity and increasing the possibility for the loss of evidence.

4. Conclusion

As observed from the data produced in this study, it is not possible to identify a single recovery method that is most effective for the recovery of touch DNA but rather that the optimal recovery method is dependent upon the surface the evidence is being recovered from. When recovering touch DNA evidence from a rough or porous surface the foam swabbing material is optimal whereas when there is a smoother surface the polyester or cotton swab may be more effective. Further research into this area is needed in order to gain an understanding of the interactions taking place in order to develop an optimal recovery strategy.

5. Conflict of Interest

None.

6. Acknowledgements

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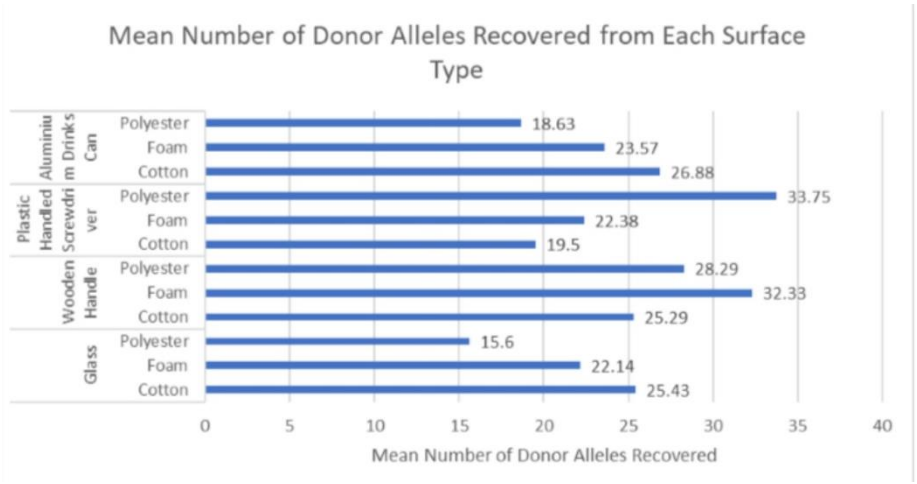

Figure 1. A graph displaying the mean number of donor alleles recovered from different surface types using different swab materials.