Initial testing of an applicator prototype to facilitate forensic DNA recovery by tapelifting

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Abstract

A tapelift used for DNA recovery can be prone to user contamination due to excessive handling when applying it to a surface and placing it into an extraction tube. Here, we present initial results from testing our newly developed applicator with tapelifts compared against the manual tapelift method. With subsequent testing of its performance across various surface types and casework scenarios, it is hoped that this applicator will revolutionise the way tapelifts are used to collect DNA at crime scenes.

Keywords: DNA recovery; DNA collection; Tapelifts; Crime scene.

Introduction

Swabs are used globally for forensic DNA collection from many substrate types, including non-porous substrates such as glass or plastic[1] and occasionally porous substrates such as fabric and clothing[2]. However, swab performance is impacted by various factors, such as application pressure and angle, wetting agent volume and type, swab type, etc[1, 3, 4]. Use of adhesive tapelifts to collect DNA can eliminate many of these factors and be as effective as swabbing, even for non-porous surfaces that are not routinely sampled by tapelifts[5]. For example, casework data analysis in our jurisdiction has shown that DNA recovery using tapelifts surpasses that from swabs for some surfaces, such as internal vehicle areas. However, tapelifts have a key drawback. The excessive handling required to apply a tapelift to a surface and then place it carefully into an extraction tube makes tape prone to contamination from the user. In response to a call for the development of a field-ready DNA collection method that minimises user contamination, is easy to use and is equal or more effective than current methods, we developed an applicator prototype for use with tapelifts to meet these aims. Evolution of the applicator's design was informed by multiple rounds of testing the performance of the applicator against manual tapelifting. This was conducted by extracting and

quantifying DNA from tapelifts used, with and without the applicator, to collect DNA from pre-cleaned substrates seeded with human saliva. Here, we present results from this testing with the final design of the applicator.

Materials and methods

Using the same tapelifts and protocol as Burmuzoska *et al.* (2022)[5], method comparison was conducted by tapelifting DNA with and without the applicator from pre-cleaned porous (cotton, polyester, denim) and non-porous (tile, brass, synthetic leather) substrates seeded with 30µl aliquots of a 50-fold or 100-fold saliva dilution (5 replicates per dilution per recovery method per substrate: n=120 plus controls). DNA from all samples was extracted and quantified, with a sub-set profiled, as per Burmuzoska *et al.* (2022)[5].

Results

Tapelifting with the applicator recovered similar or higher DNA amounts than those recovered by manual tapelifting for most combinations of substrates and initial seeded saliva dilution, with two exceptions (Figure 1); the first being for both saliva dilutions on the brass substrate and the second being the 1:50 dilution on polyester. The experiment was repeated for both dilutions on polyester with a further four replicates for each method (data not shown), which showed varied results with both dilutions. DNA profiling results were as expected from the quantification data.

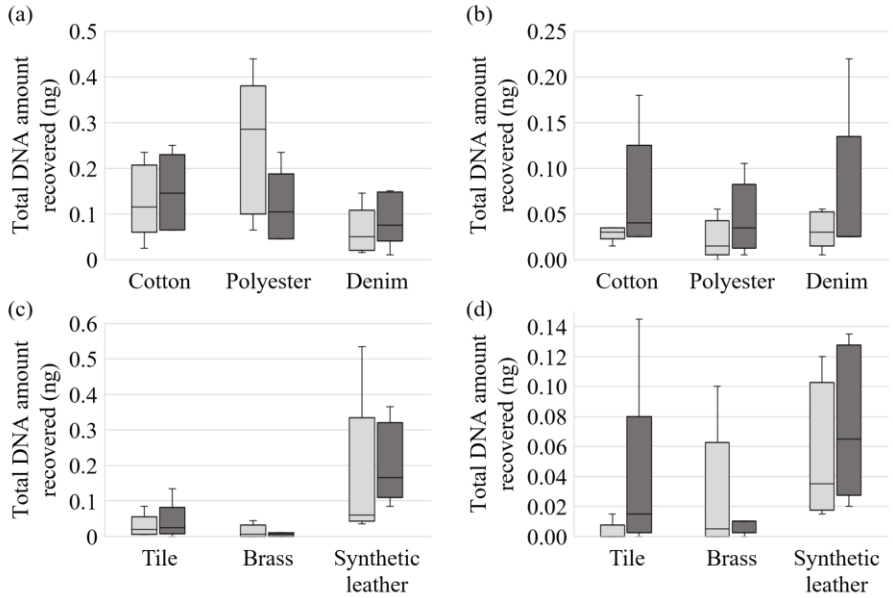

Figure 1. *DNA quantities recovered by tapelifting with (dark grey) and without (light grey) the applicator from 1:50 (a) and 1:100 (b) saliva dilutions on porous substrates, and from 1:50 (c) and 1:100 (d) saliva dilutions on non-porous substrates.*

Discussion

Here, we demonstrate that our newly developed applicator can perform as well or better than the manual tapelift method for most substrates tested, with exception of brass and polyester. Whilst the high variability observed across several substrates is likely due to the low DNA quantities recovered and stochastic nature of DNA analysis at this level, brass is known to be a challenging substrate for DNA recovery[6] and further investigation is required to establish why the polyester results were particularly varied. Testing of the applicator is ongoing with the next phases of the project to include testing the applicator on mock exhibits and comparing its performance when used by experienced crime scene examiners versus novices. Further advanced testing of its performance against manual tapelifting across various surface types and casework scenarios is planned, with the anticipation that this applicator will transform and expand the use of tapelifts to collect DNA at crime scenes.

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Conflict of interests: None.

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