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Technical note

Combined recovery of biological and fibre traces

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ABSTRACT

We present a method in which DNA and fibre traces are jointly recovered by taping. The DNA traces are isolated by standard laboratory procedures. Fibre traces are isolated afterwards in order to improve efficiency.
Two tests have been carried out to evaluate the suitability of the presented method. In the first test, possible changes in appearance of fibres due to the DNA isolation procedures are investigated. In the second test, the recovery of fibres from a contaminated surface and their possible loss due to the DNA isolation procedure are investigated.
It is concluded that polyester fibres are hardly affected by the DNA isolation procedure. In contrast, a relatively large number of the investigated cotton fibres were altered. The observed differences do not indicate a structural damage to the fibre or the dyes, but rather the washing-out of some components. The observed changes may require that fibres from a known source are also exposed to the DNA isolation procedures to assess the induced changes, but do not prevent a meaningful comparison. The recovery of fibres is slightly lower than the routine procedures for fibre recovery. Therefore, it was decided to perform extra taping of the recipient in cases where fibre investigation is requested.
During DNA-isolation, some of the fibres present are released from the tapes. These fibres are not lost however, as they can be found on the filter in the used DNA isolation vials.

1. Introduction

Items submitted to a forensic laboratory for analysis are often much larger than the minute and relevant traces they contain. As a result, the relevant traces need to be isolated or recovered from the submitted item before a detailed analysis can take place. Fibre traces on textiles can be recovered quickly and efficiently by tape lifting, a method that was proposed several decades ago [1] and has since then become a standard in many forensic fibre laboratories [2].

Up to about a decade ago, recovery of DNA traces from textiles was mostly limited to visible traces of body fluids such as blood. As the analysed trace was visible, they could easily be recovered by cutting out a small piece of textile. With the enormous increase in the sensitivity of DNA methods, analysis of traces that are barely or not visible becomes possible. In some cases, visibility of such small traces can be increased by using an agent such as luminol for blood traces. If traces can be made visible, the search and recovery strategy is focused and efficient. However, some biological traces, most notably skin cells are too small to observe by bare eye and cannot be classified or visualised by current aids or agents [3]. Nevertheless, minute traces consisting of only a few cells can still yield a useful DNA profile [4,5].

In recent years, tape lifts have received much attention [6–9], and recovery of traces for DNA analysis by tapes is now regularly used [5,7] in forensic practise. One of the early studies on the use of tape lifts to recover DNA traces [8] focused on the combined recovery of gun-shot residues and DNA traces.

The development of highly sensitive DNA techniques has thus resulted in a recovery method that closely resembles the methodology to recover fibres and other micro traces. As a result, sampling intended to recover biological traces will also recover fibre traces and vice versa. This is in principle powerful, as it becomes possible to gather as much information as possible from a single tape-lifts. This was shown by Schneider et al. [10], who searched fibre tape lifts from cold cases for the presence of skin cells.

Within the authors' laboratory, tape lifts are now the routine method to recover contact traces. Normally, the areas sampled for DNA analysis cover only a small part of an investigated item, as complete sampling would take huge resources. The samplings are restricted to locations where contact (e.g. between the victim and the suspect) are to be expected. Such expectations are based on experience, common sense and the description of the incident provided by e.g. the police. Obviously, the remaining, non-sampled parts are available for fibre analysis. However, if the sampling for DNA evidence was carried out on the

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correct location, but the skin of the perpetrator was covered by a glove, most of the relevant textile traces would be lost for fibre examinations. Therefore, an approach was sought to enable combined investigation of fibre and DNA evidence. A first strategy included the manual isolation of fibres from the used tapes before the tapes were submitted for DNA analysis. This method is feasible, but turned out to be inefficient. The reason for this is that DNA investigations are often useful in the investigative phase of an investigation, as an unknown perpetrator might be identified due to comparison of recovered traces with databases. On the other hand, fibre investigations are more commonly carried out during the evaluative phase, where materials from a suspect are available for analysis. The first strategy requires that the fibre examiner isolates fibres from all relevant tapes, which is time consuming and useless in cases were no evaluative investigation is requested afterwards. In addition, it can be anticipated that isolation of the fibre traces leads to the loss of part of the present DNA traces.

Therefore, we explored ways towards a more efficient, combined recovery. In the proposed strategy, tapes that are relevant for both DNA and fibre investigations are processed using the routine procedures for DNA-isolation. Afterwards, the tapes are recovered, and stored for possible use in investigative or evaluative fibre examinations. The current contribution will present our results of tests into the validity of this strategy. The validity was tested in two separate experiments.

- A stability test, outlined in Fig. 1a, in which tapes containing fibres from different sources are processed using routine procedures for DNA isolation. Afterwards, the fibres are compared to the (unprocessed) fibres from the same textile. This test is designed to analyse possible changes to fibres induced by the isolation procedures. This test were carried out using several cotton and polyester textiles, as these are the most frequently used cellulosic and synthetic materials in clothing [11] and are often encountered in case work [12–14]. This test solely focuses on the stability of the studied textiles, thereby rendering the transfer and recovery rates irrelevant. For this reason, the stability tests were carried out with fibres comprising the known sources.
- An efficiency test, outlined in Fig. 1b, in which the number of fibre traces recovered is compared to the original number of fibre traces present on the investigated item. This test is needed as the laboratory procedures for DNA recovery differ from the routine microtrace procedures. Most notably, the dimensions of the tapes used for DNA recovery (~1 cm^2) is limited, as larger tapes are not compatible with the DNA isolation procedure. Earlier tests have shown that the recovery by the double sided Scapa tape is similar to other current tapes [15]. However, the used tapes are small and are adhered to a textile several times to concentrate available material. It can be anticipated that fibre recovery is less complete due to this repeated adherence. Furthermore, it can be anticipated that the DNA isolation procedure leads to the loss of fibres due to the influence of fluids and heating.

2. Experimental

2.1. Samples and materials

Stability tests were carried out using a set of 80 sources, consisting of 20 polyester references and 20 cotton references. The reference materials, numbered 'PES ref 1–20' and 'Co ref 1–20', contain different dyes and were selected to represent a wide selection of different textiles. They are obtained from Chemische fabriek Triade, Naaldwijk the Netherlands and Regency ltd, Rossendale, UK). In addition, 20 polyester and 20 cotton samples were collected from garments or other common items. This set was included in the study as it is more representative of items that can be expected in routine case work. These are named 'PES

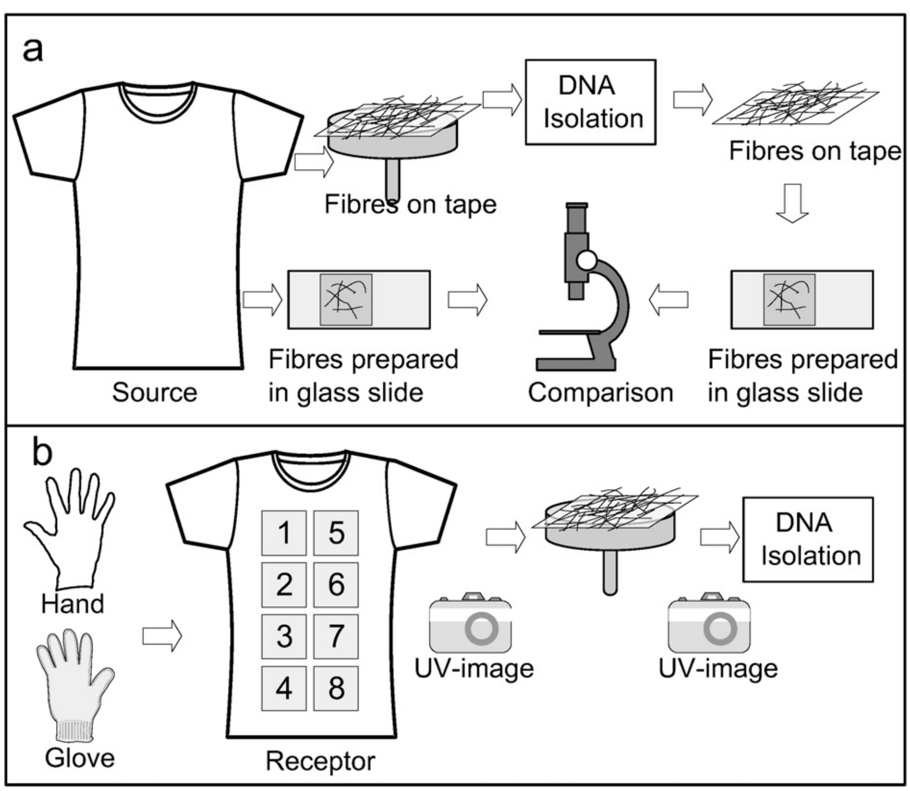

Fig. 1. a) Experimental procedure for testing of fibre stability. In this procedure, fibres from a known source are transferred to tape direct adhesion. The tape is than submitted to the DNA isolation procedure. Afterwards, fibres exposed to the DNA extraction procedure are compared to the original fibres. b) Experimental procedure for testing the efficiency of the recovery. In this procedure, traces (saliva, skin cells, fibres) are transferred to marked areas on a receptor (see sampling scheme in Table 1). The areas are sampled individually using tapes and the tapes exposed to the DNA-isolation procedure. Images of the present fibres are taken at the various stages in this procedure.