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Retrieval of DNA and genetic profiles from swabs taken inside cars

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Abstract. In two studies of swabs taken inside cars, the success rates of retrieving DNA and genetic profiles were estimated. Study I comprised data from actual casework analysed in the period 2003–2004. In Study II, swabs from cars were made by one police officer in a controlled experiment. The overall success rate of retrieving sufficient DNA from the swabs was 22% in Study I and 86% in Study II. The success rate was not influenced by the amount of water used for the swabs or on the storage conditions. The sampling technique seemed to be responsible for the differences in success rate between the two studies. © 2006 Elsevier B.V. All rights reserved.

Keywords: Crime casework; Controlled experiment; Swab from cars; DNA retrieval; DNA profile

1. Introduction

In a survey of crime case samples collected from the interior of cars in the period 2003–2004, the success rate of retrieving genetic profiles from cotton swabs was estimated. In a more controlled experiment, we tested if the amount of water and the storage conditions of swabs taken from steering wheels and spooks influenced the retrieval of DNA.

2. Material and methods

2.1. Study I

The survey of the swab samples was based on actual casework in the period of 2003–2004. DNA was extracted from the swabs using the Chelex® method and concentrated using Centricons®. DNA concentration of the extracts was quantified with a slot blot method [1]. DNA profiling was performed using the AmpFlSTR®-SGM-Plus™ kit with 28 cycles PCR.

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Table 1
DNA retrieval from different interior parts of the cars

Location	Samples	DNA retrieval	DNA profile	Success rate (%)
Wheel	95	65	27	28.4
Gearshift	62	35	10	16.1
Handbrake	12	6	2	16.7
Door handle	16	5	2	12.5
Window	36	9	4	11.1
Headrest	6	6	4	66.7
Other	21	13	6	28.6
Combined	248	139	55	22.2

The total number of samples was more than 241 because, in some cases, swabs were made from more than one location in the car.

2.2. Study II

The controlled experiment was made under restricted conditions. One police officer made swabs from steering wheels and spokes in 14 different cars. All swabs were taken from delimited areas. The experiment was divided into two series. Swabs were made with 1 versus 4 drops of water and then air-dried (series 1), or swabs were made using 4 drops of water and then air-dried versus frozen (series 2).

The first seven cars were used to test the amount of water and the last seven for the storage experiment. Limited areas on the wheel and the spoke in each car were used to test one set of conditions and another limited area for the other set of conditions. DNA was extracted from all samples as described above. The DNA was quantified with the Quantifiler™ kit [2] and DNA profiling was performed as before.

3. Results and discussion

3.1. Study I

A total of 241 car interior swab samples was analysed from actual casework in 2003–2004. Only 23% of the samples had a DNA concentration >0.02 ng/μl (lower limit for

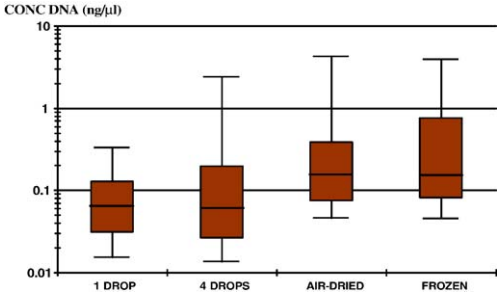

Fig. 1. A boxplot representing the concentration of DNA (on a logarithmic scale) extracted from the cotton swabs using four different methods: 1 versus 4 drops of water or air-drying versus freezing. The median for each data set is indicated by the black centerline, and the first and third quartiles are the edges of the box area, which is known as the inter-quartile range (IQR). The highest and lowest DNA-concentration within each data set is indicated by the vertical lines from the red boxes. Each data set consists of 14 measurements made as duplicate analyses. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

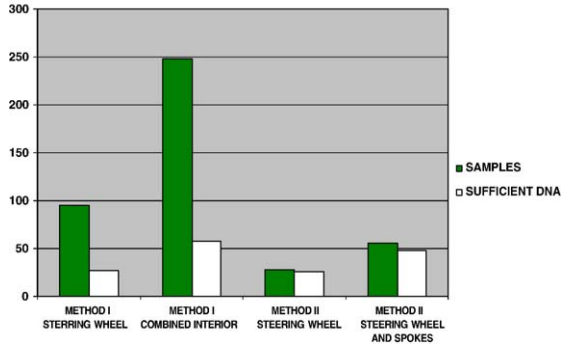

Fig. 2. Comparison of Study I and Study II. The dark columns indicate the number of samples taken in each group, and the white columns indicate the number of samples from which sufficient amounts of DNA were extracted (<0.02 ng/μl in Study I and <0.04 ng/μl in Study II). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

PCR amplification). STR profiles were retrieved for all but three of these samples (overall success rate 22%). In 96% of the STR-profiles, more than 7 STR-loci were obtained. In 62% of the cases where a DNA-profile was obtained, a DNA profile from the suspect was also observed. In 56% of these cases, a match between the profiles was found. The casework also showed differences in the DNA retrieval from various locations of the interior of the car (Table 1).

The samples in the casework were collected by five different police units (I, II, III, IV and V) and the success rate for the units varied from 14% to 34%. This indicated that the sampling technique played a major role for the success rate.

3.2. Study II

In the controlled experiment, one police officer collected 56 samples from 14 cars. In 86% of the samples, a DNA concentration >0.04 ng/μl was retrieved (range 0.01–5.6 ng/μl). DNA analysis was performed on 24 samples (6 samples from each group chosen at random) and a DNA profile was obtained for all of them (all but one had more than 7 STR-loci). No significant difference in the amount of DNA retrieved from the swabs was seen when 1 versus 4 drops of water was used for the swabs. Also, no significant difference was seen when swabs were air-dried versus frozen (Fig. 1). The two studies are compared in Fig. 2.

The high success rate for the samples from the controlled experiment (93% for steering wheel and 86% for steering wheel and spokes) compared to the crime case samples (28% for steering wheel and 23% for combined interior) could be contributed only to the sampling technique where the swabs were taken by thoroughly wiping a delimited area.

References

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[2] Quantifiler kits user manual (2003) Applied Biosystems.