



## Efficiency of Casework Direct Kit for extraction of touch DNA samples obtained from cars steering wheels

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### ABSTRACT

Analysis of STR profiles obtained from touch DNA has been very useful to the elucidation of crimes. Extraction method may be determinant for the recovery of genetic material collected from different surfaces. Vehicle theft is one of the most common crimes in São Paulo city, Brazil, but collection of biological traces in car steering wheels is not considered, because of the belief that profiles generated won't be able to identify the thief, only the owner. This study aimed to analyze the efficacy of extraction methods for obtaining DNA profiles in samples collected from steering wheels. Eight criminal acts were simulated with 2 different individuals each (mixture of victim and thief), in duplicate, in order to compare two extraction methods: DNA IQ™ and Casework Direct Kit (both Promega Corporation). Genetic material was collected by double swab method and quantified by Quantifiler™ Trio (ThermoFisher Scientific). Amplification was conducted with PowerPlex® Fusion System (Promega). It was possible to obtain STR profiles for all experiments. The mixtures were compared with reference profiles to evaluate how many alleles of each donor were observed. Samples extracted with Casework Direct Kit obtained STR profiles with higher averages of alleles for primary and secondary donors (88.7% and 59.9%, respectively) than those extracted with DNA IQ™ (60.4% and 38.1%, respectively). This could be explained by the differences established in the protocols of both methods, since DNA IQ™ is based on successive washes and can result in loss of DNA, whereas Casework Direct Kit minimizes this problem. We concluded that Casework Direct Kit was more efficient for processing touch DNA samples than DNA IQ™.

### 1. Introduction

Although, theoretically, it is possible to obtain DNA from any biological source, the amount of genetic material that can be extracted from each evidence to generate DNA profiles may vary [1].

One of the most common evidence found in crime scenes is fingerprints, and skin surface represents a great potential source for obtaining DNA profiles [2]. Touch DNA samples contain low quantity of DNA [2,3,4,5] and the capability to obtain a genetic profile from those samples can make difference to solve a crime.

The feasibility of producing DNA profiles will depend on the quality and quantity of the extracted DNA. Variation in the amount of DNA left in an object that has been manipulated may depend on a number of factors [6], such as the status shedder, pre-touch depositor activities [7,8,9,10], as well as the type of surface where DNA is deposited and the nature of contact [11,12]. In those cases, the DNA extraction is essential to get positive results.

In Brazil, with the establishment of the National Database of Genetic Profiles in 2013, there is a growing demand for using DNA profiles, and

currently DNA forensic laboratories receive a large amount of touch DNA samples from crime scene due to the popularization of this type of examination and the increase in crime. Data from 2018 showed that 25.7% of all theft in São Paulo were crimes involving vehicles.

This study aimed to analyze the efficacy of two extraction methods for obtaining DNA profiles in samples collected from cars steering wheels.

### 2. Methods

Eight simulated experiments were conducted with six participants and four cars. Each car had an owner who used it daily (first contributors). The other participants (a man and a woman/second contributors) manipulated the steering wheels of each car during one minute, simulating a theft. The experiments were done in different days (steering wheels were sterilized before each experiment with 70% alcohol) and in duplicate in order to test 2 extraction kits, DNA IQ™ and Casework Direct Kit (both Promega Corporation). The biological material was collected by the double swab method [13].

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**Table 1**

Percentage of alleles from both individuals in the mixture for each STR profile generated and number of STR markers with allelic correspondence to second donors.

Experiment	No. of alleles from first donator (reference profile) <sup>a</sup>	No. of alleles from first donators (mixture profile)	%	No. of alleles from second donator (reference profile) <sup>a</sup>	No. of alleles from second donators (mixture profile)	%	No. of STR markers with allelic correspondence to second donator
<b>DNA IQ</b>							
1	44	23	52,3	40	28	70	18
3	40	37	92,5	40	14	35	8
5	44	31	70,4	40	18	45	15
7	40	30	75	40	25	62,5	17
9	44	8	18,2	42	7	16,6	6
11	40	37	92,5	42	15	35,7	10
13	44	22	55	42	8	19	6
15	40	11	27,5	42	9	21,4	6
<b>CASEWORK DIRECT KIT</b>							
2	44	33	75	40	28	70	18
4	40	39	97,5	40	23	57,5	16
6	44	38	86,4	40	24	60	17
8	40	39	97,5	40	36	90	19
10	44	28	63,6	42	29	69	18
12	40	38	95	42	17	40,5	13
14	44	44	100	42	18	42,8	13
16	40	38	95	42	21	50	13

<sup>a</sup> Homozygous alleles were counted only one time.

Reference profiles of each participant was done from blood collected in FTA card (Whatman®) in order to compare with the mixtures profiles obtained from the experiments.

DNA extraction from samples collected in the experiments was done according manufacture's protocols, respectively to each kit. After extraction, all samples were quantified by Quantifiler Trio™ (Applied Biosystems) and amplified by PowerPlex Fusion System (Promega Corporation). Reference samples were amplified with 26 PCR cycles while experiment samples were done with 31 PCR cycles. The amplified products were submitted to the capillary electrophoresis in the ABI3130 (Applied Biosystems) and were analyzed using GeneMapper ID software v3.2. Only peaks above 50 RFU were interpreted.

Total number of alleles with correspondence between the observed and the expected profile was counted and represented by percentage. The utility of these profiles was evaluated according to the Operational Procedures Manual of National DNA Index System (NDIS) [14], that established at least 8 STR markers present in original CODIS are necessary to consider a useful profile to an investigation.

### 3. Results

Samples extracted with Casework Direct Kit obtained STR profiles with higher averages of alleles for primary and secondary donors (88.7% and 59.9%, respectively) than those extracted with DNA IQ™ (60.4% and 38.1%) (Table 1).

### 4. Discussion

The results clearly show the Casework Direct kit's greater efficiency in recovering biological material deposited on car steering wheels, regardless of the mix composition (male/female, female/female or male/female) compared to DNA IQ™.

Although fingerprints represent a potential source of genetic material to generate STR profiles, the extraction method used can be a crucial factor in altering the chances of obtaining these profiles. The two extraction kits used are suitable for forensic samples such as touch DNA samples. Probably the observed difference is a result of the strategy of each kit since the DNA IQ™ method is based on successive washes using magnetic enzyme, which can lead to excessive DNA loss, while Casework Direct Kit is based on the use of a membrane lysis solution, minimizing loss, as described on the validation study (Promega Corporation website) [15].

Although the results showed the secondary donor was the minority component of the mixture in almost all experiments except 2 (1 and 10), 13 of the 16 partial profiles generated (81.2%) could be useful in identifying criminals once they would comprise more than 8 STR markers, a prerequisite for the profile to be inserted into the National DataBank of Genetic Profiles.

### 5. Conclusion

The extraction method with the Casework Direct Kit was more effective for the recovery of genetic material deposited than the DNA IQ™ kit, both in relation to the average of true alleles present in the profiles, as well as the lower percentage of drop-out and drop-in (data not shown).

The high success rate in obtaining STR profiles from car steering wheels demonstrates that DNA collection from this surface can be a powerful crime solving tool, as this material is capable of retaining biological traces from touch DNA even having been manipulated for a short time.

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### Declaration of Competing Interest

None.

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