The Recovery of Latent Fingermarks and DNA using a Silicone-Based Casting Material

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The recovery of latent fingermarks and DNA using a silicone-based casting material

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Abstract

There are many techniques available for the recovery of fingermarks at scenes of crime including the possibility of taking casts of the marks. Casts can be advantageous in cases where other destructive recovery techniques might not be suitable, such as when recovering finger marks deposited on valued or immobile items.

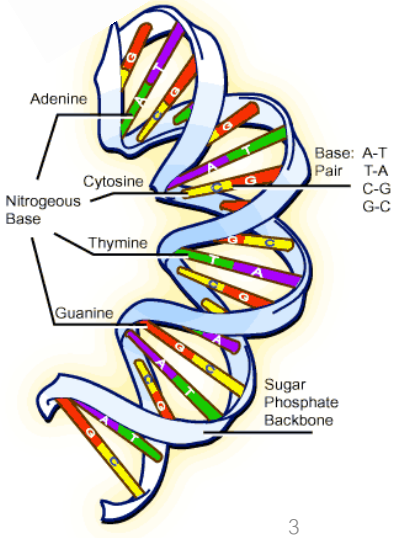
In this research, Isomark™ (a silicone-based casting material) was used to recover casts of finger marks placed on a variety of substrates. Casts were enhanced using cyanoacrylate fuming. Good quality marks were successfully recovered from a range of smooth, non-porous surfaces. Recovery from semi-porous surfaces was shown to be inefficient.

DNA was subsequently extracted from the casts using QIAamp® Mini extraction kits, amplified and profiled. Full DNA profiles were obtained 34% of samples extracted.

Keywords: Forensic science; Finger mark; Casting; Isomark™; DNA profiling

Now a day

- Many techniques to recover the fingerprints from the crime scene
- The possibilities to collect DNAs



One of them, ISOMARK™

- ISOMARK™, an ideal casting material for many forensic purposes
  - Tool marks
  - Foot and Tire prints
  - Ballistics
  - **Latent finger marks and DNA retrieval**

Advantages

- Non-destructive
- 0.1 mm. marks reproducible
- The possibilities of collecting DNAs
- Reliable, specifically designed for forensic usages

Objectives

1. To compare the quality of the ISOMARK™ recovered from different substrates

2. To compare the quality of the finger marks, using ISOMARK™ and directly on the substrates

3. To compare the Quality and Quantity of DNA, extracted from ISOMARK™ and substrates

Materials and Methods

- Fingermarks Deposition
- Recovery and Enhancement
- DNA Collection and Extraction
- DNA Quantification, Amplification and Profiling
- Statistical Analysis

Finger Marks Deposition

- Controlled manner **from washed** hand
  - Aluminium can
  - Plastic Bottle
  - 2£ Coin
  - Waxy paper cup
  - Light bulb
  - Hard plastic mobile phone

- Realistic manner **from unwashed** hand
  - Aluminium can
  - Plastic Bottle
  - Waxy paper cup

Recovery and Enhancment

- Recovery using ISOMARK™
  - Being dispensed 1 hr. after deposited
  - Leave 24 hr. before developing
- Cyanoacrylate Enchantment
  - To Enhance the finger marks quality
  - In the controlled atmosphere (20 mins; 80% humidity; 120 °C)
- Take photos and assess by Integrated Rapid Imaging System (IRIS)

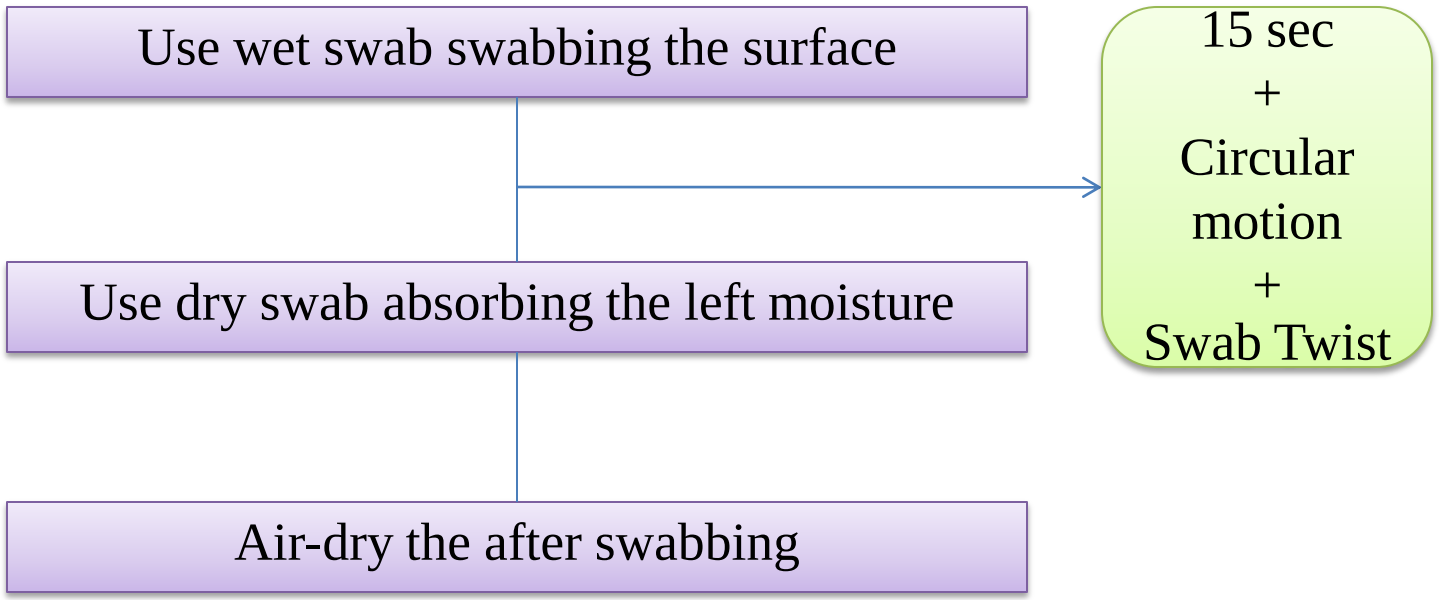
DNA Collection

- Collect from the substrate's surface using **"Double Swab Technique"**

- Collect from the ISOMARK™ by slicing into pieces using sterile scalpel

Double Swab Technique

- An approved technique for collecting DNA from touched evidences
- Steps



Double swab technique for collecting touched evidence; 2007

DNA Extraction I

- Follow the manufacturer's instruction
- Steps

Place swab heads into 2 ml microcentrifuge tube

Put the sliced ISOMARK™ into 2 ml microcentrifuge tube

Add 20 µl QIAGEN Protease + 400 µl Buffer AL

Vortex Mix 15 sec

Incubate 10 min and briefly centrifuge

Add 400 µl absolute ethanol and briefly centrifuge

QIAamp® DNA Mini Kit and QIAamp DNA Blood Mini Kit Handbook; 2001

DNA Extraction II

Apply 700 µl to QIAamp spin column

Place column in a clean 2ml collection tube

Centrifuge at 6000g

Repeat all the remaining mixture

Add 500 µl buffer AW1; centrifuge at 6000g 1 min

Place column in a clean 2ml collection tube

Add 500 µl buffer AW2; centrifuge at 20000g 3 min

Place column in a new 1.5 ml microcentrifuge tube

Elution with 150 µl buffer AE; Incubate 1 min; centrifuge at 6000g 1 min

DNA Quantification

- Concentrated using Microcon® Ultracell YM-100
- Using Quantifiler™ Human DNA Quantification Kit
- Perform Quantification in an ABI PRISM® 7000

DNA Amplification and Profiling

- Perform using the AmpF/STR® SGM Plus® Kit
- A 28 cycle amplification, follow the manufacturer's protocol; **The final volume = 25 µl**
- Profile using ABI PRISM® 310 Genetic Analyser

Statistical Analysis

- SPSS
- Univariate Analysis of variance (95% statistical level)

Result

- Finger mark analysis
- Controlled Finger marks
- Realistic Finger marks

Finger Marks Analysis

- Score using Classification System; Scoring 0-8

Table 1
Quality of controlled marks recovered using Isomark™

Substrate	Mark quality (Iso)		Mark quality (Sub)	
	Average score	σ	Average score	σ
Aluminium can	4.2	1.10	2.4	1.34
Base of plastic bottle	4.8	2.05	5.8	2.17
£2 coin	5.0	2.00	6.0	1.87
Cup	0.6	1.34	0.0	0.00
Light bulb	4.0	0.71	3.0	0.00
Mobile phone case	0.0	0.00	0.4	0.89

Table 2
Characterisation of realistic marks recovered using Isomark™

Object	Mark quality (Iso)		Mark quality (Sub)	
	Average score	σ	Average score	σ
Aluminium can	7.00	1.55	5.83	2.48
Base of plastic bottle	4.33	2.66	2.83	1.60
Cup	0.00	0.00	0.00	0.00

Controlled Finger Marks

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Mobile phone case	0.0	0.00	0.4	0.89

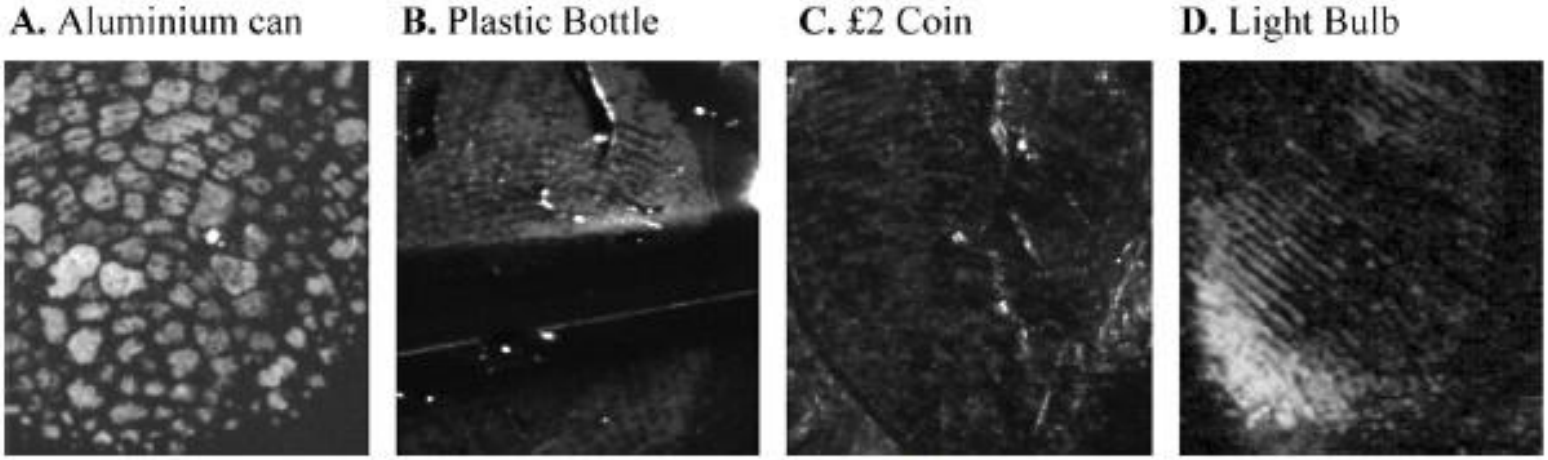

Fig. 1. CNA developed Isomark™ samples.

Realistic Finger Mark

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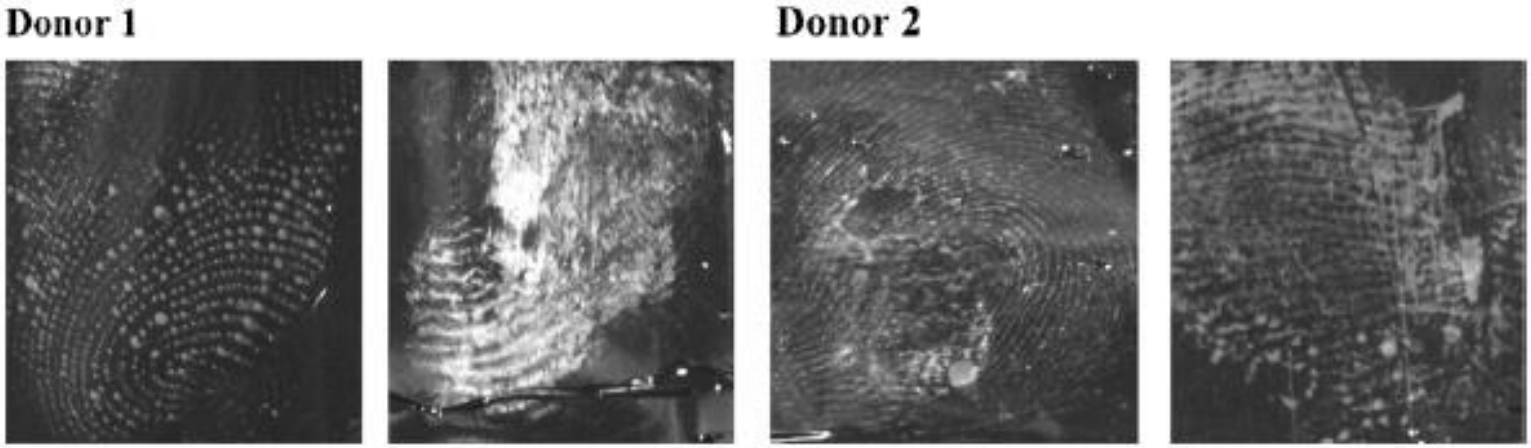

Fig. 2. CNA developed Isomark™ samples. Realistically deposited marks recovered using Isomark™ on two substrates by two donors.

DNA Analysis

- Controlled Finger Marks
- Realistic Finger Marks

Controlled Finger Marks

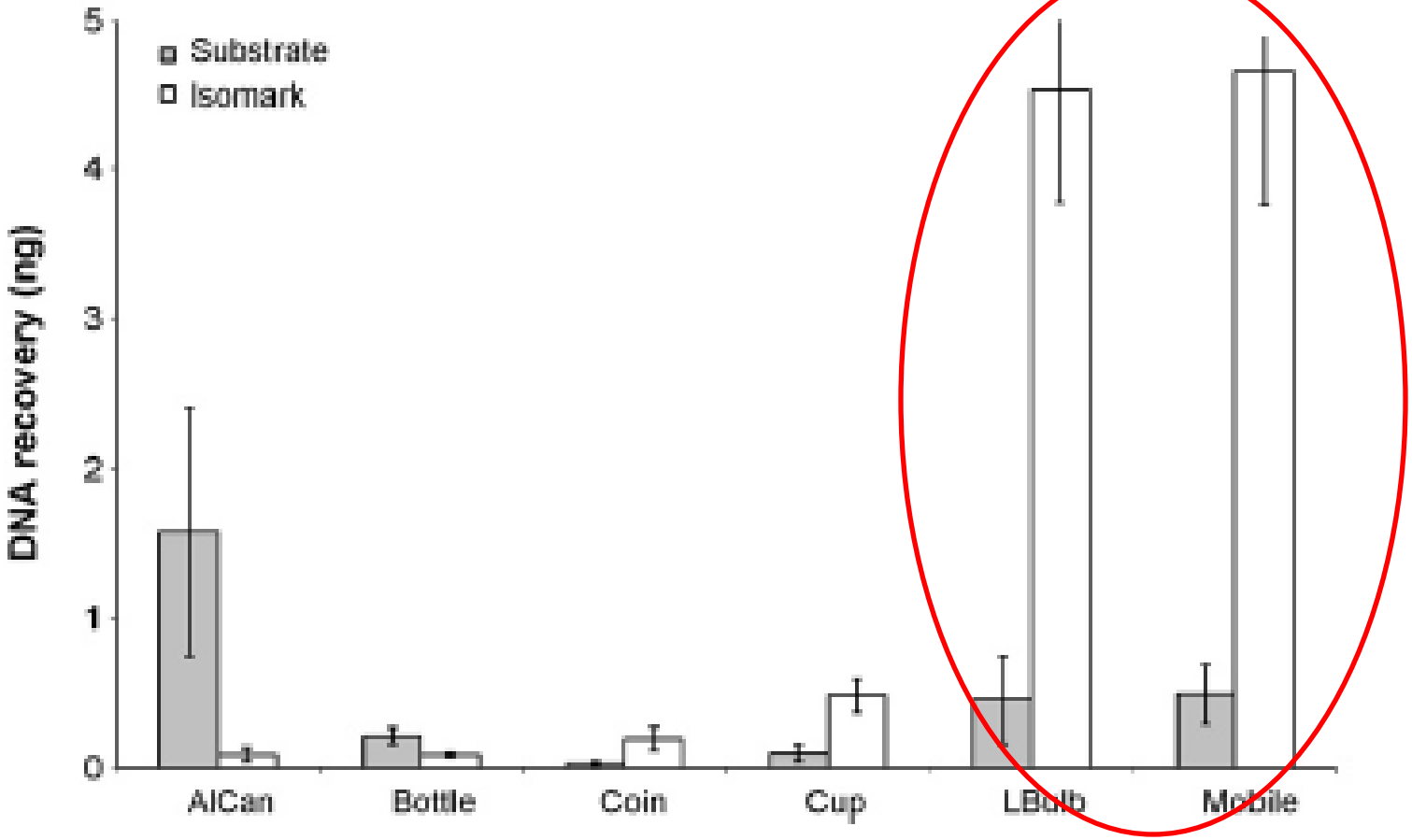

Fig. 3. Average amount of DNA (ng) recovered from controlled finger marks. The marks obtained were from a single donor ($n = 5$). DNA was recovered from both the original object and the Isomark™. Error bars depict standard error.

Realistic Finger Marks

- Samples that yield DNA over 0.1 ng/µl were profiled
  - 42 % profiled
  - 82 % obtained full DNA profile
  - 34 % of total

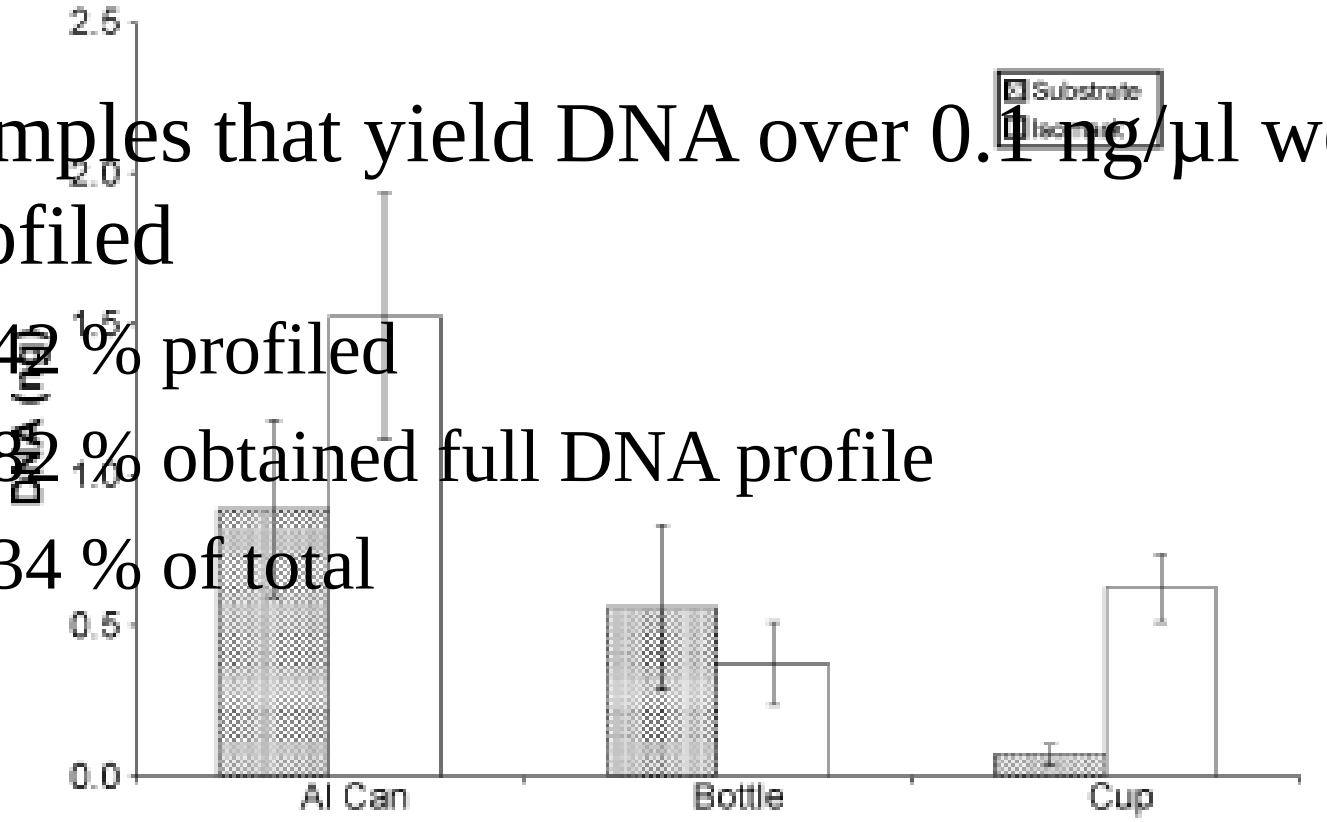

Fig. 4. The amount of DNA recovered from realistic marks. The marks obtained were from two donors ($n = 6$). DNA was recovered from both the original object and the Isomark™. The average amount of DNA is given. Error bars show standard error.

Discussions I

- ISOMARK™ make CNA fuming easier, and work well with smooth non-porous surface
- There is condensed water on the aluminium can's surface which make an unrealistic situation
- The mark, developed by ISOMARK™ is similar quality to what left on the substrate
- The quality of the ISOMARK™ is affected by the bubble between ISOMARK™ and substrate

Discussions II

- The variable quantity of DNA, extracted from ISOMARK™ may be caused by uneven distribution of latent, uneven pressure of application or other factors
- Most case, more DNA is recovered from ISOMARK™, but not on the Aluminium can's surface may be due to the smooth and non-porous do not retain epithelial cells well

Discussions III

- DNA profiling will be used in the case that the finger marks damage

Conclusions I

- ISOMARK™ work very well for recovering finger marks from aluminium can, plastic bottle, coin and light bulb even the further tests need to be performed
- ISOMARK™ is not suitable for recovering finger marks from semi-porous and porous surfaces
- It is possible to recover DNA from ISOMARK™ casts made on any substrates
- No link between quality of the finger marks and amount of DNA

Conclusions II

- The results of this experiment suggest the ISOMARK™ to be an alternative way to collect finger marks and DNA

Special Thanks

- **Pol.Lt.Col. Kitsada Ribruamsub**

Thank You For Your Attentions