Summary of Experiments Investigating the Impact of Fingerprint Processing and Fingerprint Reagents on PCR-based DNA Typing Profiles

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Introduction and Methods

This experiment looked at the impact of single and multiple reagents on the ability to obtain a PCR-based DNA profile from single, bloody fingerprints. Bloody fingerprints were made and given to staff in the Latent Print Unit. These prints were made on a variety of different substrates. These substrates were both non-porous and porous and included the following objects: newspaper, paper, plastic bags, aluminum cans, glass, duct tape and wood/metal knifes. In addition, skin prints were made on the adhesive side of duct tape and subjected to various fingerprinting reagents. Latent Print Unit staff performed the fingerprint processing work using the following reagents:

Un-du
Un-du + Ninhydrin
Physical Developer
Ninhydrin
Vacuum Metal Deposition
Amido Black
Amido Black+ Leuco Crystal Violet
Leuco Crystal Violet
Genetian Violet
Cyanoacrylate + Sudan Black
Cyanoacrylate + Rhodamine 6G
Cyanoacrylate + Rhodamine 6G + Powder
Cyanoacrylate + Rhodamine 6G + Vacuum Metal Deposition
Stickyside Powder
Un-du + Stickyside Powder

The processed prints were then returned to CCI staff. CCI staff extracted, quantitated, amplified and typed the DNA from each of the processed bloody prints.

Results

Although the use of the fingerprint reagents resulted in a loss of DNA from the bloody prints compared to the untreated, bloody control prints, DNA

profiles were obtained in 30 out of 31 test samples. The DNA yield from the treated bloody prints was often very low or non-detectable. This result was probably influenced by the low sensitivity of the quantitation test used in this study. However, these low DNA yields did **not** prevent complete typing profiles from being obtained from the processed prints. Of the 31 bloody prints that were processed for fingerprints in this study and typed for DNA, **DNA profiles were obtained for 30 out of 31 of these treated prints. The only reagents which appeared to have a pronounced negative impact on the ability to obtain a PCR-based DNA profile was the "Stickyside" powder reagent in combination with the "Un-du" reagent. Although it was still possible to obtain a borderline profile with the "Stickyside" powder reagent by itself, when the "Stickyside" powder reagent was used in combination with the "Un-du" reagent, no DNA profile was obtained.**

Conclusions

There are several conclusions that can be drawn from this work:

- The vast majority of the fingerprint processing techniques do **not** preclude the ability to obtain a complete STR profile on a single, bloody fingerprint
  - The exception to this generalization is the fingerprint processing technique that utilizes "Stickyside" powder. No DNA profile was obtained from a print placed on the adhesive side of duct tape and treated with the "Stickyside" powder reagent and the "Un-du" solution.
    - If it is important to obtain a DNA profile, do **not** process the item using "Stickyside" powder and "Un-du".

- Less DNA was recovered from processed, bloody fingerprints than from untreated bloody fingerprints.
  - Often times, very little DNA was recovered.

- The minimal amount of DNA recovered from processed bloody prints will likely mean that, most of the time, the entire extracted sample will be required to obtain a DNA typing result.

- Since it is clear that DNA is lost during fingerprint processing, the best approach to obtaining **both** a fingerprint **and** a DNA result may be to **select the best fingerprint processing technique with the fewest reagents/steps**.

SUMMARY OF THE IMPACT OF FINGERPRINT REAGENTS ON THE ABILITY TO OBTAIN TYPING RESULTS USING PCR-BASED DNA METHODS OR CONVENTIONAL TYPING METHODS

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Treatment of bloodstain on swab using:	**PCR-based DNA Typing**	**Conventional Typing**	**Reference**
Amido Black	OK		(1)CCI/ DOJ Latent Print Unit 2002
DFO (diaza-fluorenone)	OK		
Fluorescin	OK		
Leuco Crystal Violet	OK		
Merbromin	OK		
Ninhydrin (dihydroxyindane-1,3-dione)	OK		
UV Light	Use with care		
Fingerprint Processing of Single Bloody Prints with:			
Un-do	OK		CCI/ DOJ Latent Print Unit 2003
Un-do + Ninhydrin	OK		
Ninhydrin	OK		
Vacuum Metal Deposition	OK		
Amido Black	OK		
Amido Black+ Leuco Crystal Violet	OK		
Leuco Crystal Violet	OK		
Physical Developer	Use with care		
Genetian Violet	OK		
Cyanoacrylate + Sudan Black	OK		
Cyanoacrylate + Rhodamine 6G	OK		
Cyanoacrylate + Rhodamine 6G + Powder	OK		
Cyanoacrylate + Rhodamine 6G + Vacuum Metal Deposition	OK		
Stickyside Powder	Not OK		
Un-do + Stickyside Powder	Not OK		

Treatment	PCR-based DNA Typing	Conventional Typing	Reference
PD (physical developer) after DFO (diaza-fluorenone)	OK		(2) Roux
PD after ninhydrin with Cd salt	OK		
White & aluminum powder	OK		
Cyanoacrylate with gentian violet or ardox	OK		
Ninhydrin w/secondary metal salt	Use with care		
DFO (diaza-fluorenone)	Use with care		
Amido Black	Use with care		
DAB (diaminobenzidine)	Use with care		
Black powder	Use with care		
Cyanoacrylate with rhodamine	Use with care		
Luminol	Use with care		
Magnetic powder	Not OK		
MMD (multimetal deposition)	Not OK		
UV light	Not OK		
Forensic light source/cyanoacrylate Fuming/BY-40 stain/Crystal violet stain	OK		(3) Zamir
Cyanoacrylate/black powder	OK		(4) Newhall
Ninhydrin	OK		(5) Presley
DFO & ninhydrin	OK		
ESDA	OK		
Physical Developer	Variable		

Treatment	PCR-based DNA Typing	RFLP DNA Typing	Reference
Cyanoacrylate ester fuming		OK	(6)Shipp
Argon ion laser light		OK	
Alternate light sources		OK	
Cyanoacrylate ester fuming	OK		(7)Stein
Genetian violet	OK		
Ninhydrin	OK		
Amido Black	OK		(8)Fregeau
Crowle's Double stain	Use with care		
DFO	OK		
Hungarian Red	Use with care		
Leucomalachite green	OK		
Luminol	OK		
Ninhydrin	OK		
Treatment	**PCR-based DNA Typing**	**Conventional Typing**	**Reference**
Rhodamine		Not OK	(9) Lee
Ninhydrin		Not OK	
Genetian Violet		Not OK	
Freon		OK	
Cyanoacrylate		OK	
Powders		OK	(10) Bowen
Silver Nitrate		Not OK	
Ninhydrin		Variable	
Crystal Violet		OK	
Zinc Chloride		OK	
Cyanoacrylate		OK	
Cyano. + Rhodamine		Variable	
Laser		OK	

Please bear in mind that this table reflects only the chemical impact on biological samples. If the mechanical process of developing prints results in a loss of the biological sample [much more likely if the fingerprint processing requires destaining], this loss of sample may be sufficient to result in negative typing results.

Use with care means that if the biological stain is not marginal, this process will probably be OK. Choose the best fingerprint processing technique with the fewest steps or reagents. If appropriate personnel are available, work with a serologist or DNA analyst to collect bloodstains that do not contain relevant ridge detail.

Variable means that some of the systems/loci used to type biological samples were negatively impacted but other systems/loci were OK.

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