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THE EFFECTS OF FINGERPRINTING TECHNIQUES ON BLOOD GROUPING AND DNA ANALYSIS

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Introduction

Police forces use many different methods to identify fingerprints on a variety of materials. It is not uncommon that the items to be examined for fingerprints are blood stained or that the fingerprints themselves are in blood. The purpose of this research was to determine whether forensic blood analysis and fingerprint evidence could be obtained from the same specimen without compromising the evidential value of either.

Materials and Methods

Blood stains were applied as a thin smear to both porous and non porous surfaces and treated with the fingerprinting technique appropriate to the type of surface. The chemical fingerprinting treatments were essentially those described in the Home Office Fingerprint Manual. Each of the powders were brushed over the bloodstain to give a thick coating. The laser used was a 15W "Coherent" argon ion laser and bloodstains were exposed for 1 minute.

The serological blood grouping systems tested were erythrocyte acid phosphatase (EAP), phosphoglucomutase (PGM), group specific component (Gc) and alpha-2 HS-glycoprotein (AHSG). Blood grouping was carried out using standard electrophoretic methods.

The method used for the purification of the high molecular weight DNA was that of Jeffreys et al (1985).

For the Luminol tests blood treated with various fingerprinting reagents was sprayed with the Luminol reagent.

Results

The results for the effects of the various fingerprinting treatments on the serological blood grouping systems tested are given in Table 1.

The only treatments that had no affect were colloidal gold and the powders (all of those tested except for the bronze and white and

black magnetic).

The next least destructive techniques were laser, superglue, iodine solution and the remainder of the powders. The most destructive techniques, which affected all or most of the blood grouping systems, were DFO, ninhydrin, superglue with safranine or panacryl, physical developer, DAB, amido black.

The results for the effects of the various fingerprinting treatments on DNA are given in Table 2.

The following treatments did not affect DNA: white and black fingerprint powders, superglue, laser, superglue + safranine or panacryl, superglue + safranine + laser, iodine solution.

A number of the treatments were very destructive of DNA. These included ninhydrin, DFO, physical developer, amido black.

The following fingerprinting reagents had no effect on the Luminol reaction: ninhydrin, iodine fuming, iodine solution, superglue and some powders (white, black and magnetic black).

The bronze, grey and magnetic white powders had a slight inhibiting effect but amido black, superglue + panacryl, DAB, had a major effect on Luminol.

Conclusions

It is essential that there is close liaison between fingerprint experts and forensic scientists before any fingerprinting treatments are carried out on blood stained items. Many fingerprinting methods adversely affect the Luminol reaction as well as blood analysis, both serological blood grouping systems and DNA.

References

Jeffreys A J, Wilson V, Thein S L, "Hypervariable Minisatellite regions in human DNA". Nature 314 67-73 (1985).

Manual of Fingerprint Development Techniques. Home Office Scientific Research and Development Branch, London (1986).

TABLE 1 - THE EFFECTS OF FINGERPRINTING TECHNIQUES ON BLOOD GROUPING

TECHNIQUE	Gc	AHSG	EAP	PGM
POWDERS				
white magnetic	1	+	+	+
black magnetic	1	+	+	+
bronze	+	1	1	+
grey	+	+	+	+
white	+	+	+	+
black	+	+	+	+
magnetic red fluorescent	+	+	+	+
magnetic green fluorescent	+	+	+	+
green fluorescent	+	+	+	+
pink fluorescent	+	+	+	+
red fluorescent	+	+	+	+
laser 488nm	1	+	1	+
laser 514nm	1	+	1	+
laser all lines	1	+	1	+
iodine solution	+	+	+	1
iodine fuming	+	+	-	1
DFO	1	-	-	-
ninhydrin	1	-	-	-
zinc chloride	+	+	1	1
superglue	1	+	-	+
superglue + safranine	+	1	1	-
superglue + safranine + laser	1	1	-	-
superglue + panacryl	1	1	1	+
superglue + panacryl + laser	1	1	1	+
panacryl	+	-	-	-
safranine	-	-	+	-
DAB	-	-	-	-
amido black	-	-	-	-
colloidal gold alone	+	+	+	+
multimetal deposition	-	-	-	-
physical developer	+	-	-	-

\+ no effect on blood grouping
1 some effect on blood grouping results
\- technique totally affects blood grouping so that no results can be obtained

TABLE 2: THE EFFECTS OF FINGERPRINTING TECHNIQUES ON DNA FROM BLOOD

Fingerprinting Technique	Quality of DNA detected	Surface type tested
White powder	HMW - DNA	Non porous
Black powder	HMW - DNA	Non porous
Zinc chloride	NO - DNA	Porous
Ninhydrin	DEG - DNA	Porous
Ninhydrin/Zinc chloride	NO - DNA	Porous
DFO	DEG - DNA	Porous
Methoxyninhydrin	HMW - DNA *	Porous
Physical developer	NO - DNA	Porous
Superglue	HMW - DNA	Non porous
Superglue/panacryl	HMW - DNA	Non porous
Superglue/safranine	HMW - DNA	Non porous
Amido black/5-sulphosalicylic acid	NO - DNA	Porous Non porous
Amido black/ethanol	NO - DNA	Porous Non porous
Iodine solution	HMW - DNA	Porous Non porous
Laser (488, 514nm, all lines)	HMW - DNA	Porous Non porous
Superglue/Safranine/Laser	HMW - DNA	Non Porous
Ninhydrin/Zinc chloride/Laser	NO - DNA	Porous

KEY

*	Slight degradation
HMW	High Molecular Weight DNA
NO - DNA	DNA destroyed
DEG- DNA	DNA degraded

TABLE 3: THE EFFECTS OF FINGERPRINTING TECHNIQUES ON THE REACTION OF THE LUMINOL REAGENT

FINGERPRINTING TECHNIQUE	EFFECT ON LUMINOL REACTION
white powder	none (OK)
bronze powder	slight inhibition
black powder	none (OK)
grey powder	none (OK)
magnetic white powder	slight inhibition
magnetic black powder	none (OK)
iodine fuming	none (OK)
iodine solution	none (OK)
superglue	none (OK)
superglue + panacryl	poor contrast
superglue + safranine	poor contrast
ninhydrin	none (OK)
amido black	total inhibition
DAB	considerable inhibition

COMPOSITION OF POWDERS

Black Black magnetic	1.1 w/w manganese dioxide: carbon black
white white magnetic	titanium dioxide
Bronze	bronze metal flakes
Grey	manganese dioxide: titanium dioxide - 16:84
Fluorescent Powders:	From Lightning Powder Co Inc.