Forensic Science International 280 (2017) 147–152

Contents lists available at ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

Development of fingermarks on Latex gloves: The solution to a challenging surface

Tomer Arbeli[a], Yakir Liptz[b], Ravell Bengiat[a], Michal Levin-Elad[a,*]

[a] Latent Fingerprint Laboratory, Division of Identification and Forensic Science (DIFS), Israel Police, National H.Q., Jerusalem, 9780204, Israel
[b] Fingerprint Identification and AFIS Laboratory, Division of Identification and Forensic Science (DIFS), Israel Police, National H.Q., Jerusalem, 9780204, Israel

ARTICLE INFO

Article history:
Received 13 August 2017
Received in revised form 11 September 2017
Accepted 19 September 2017
Available online 28 September 2017

Keywords:
Latex gloves
Ninhydrin
Latent fingerprints
Fingermarks development
HFE-7100

ABSTRACT

Used Latex gloves found at crime scenes can provide strong evidence against a suspect as they almost certainly contain both the fingermarks and DNA of the perpetrator who had worn them. However, over the years, Latex gloves have proved to be a rather difficult substrate for fingermarks development, with most of the standard techniques producing poor results. In this study, the two main protocols for development on either porous or non-porous surfaces: Ninhydrin-HFE and superglue fuming followed by crystal violet (CV) dyeing, respectively, had been examined on 100 disposable Latex gloves from twenty five donors. The results distinctly showed a high superiority of Ninhydrin-HFE over the superglue fuming indicating the porous rather than the non-porous properties of the interior of the gloves. Yet, not all the usual ninhydrin development formulations yielded the desirable results, leading to the conclusion that the success of development rests on the solvent-sensitive structure of the gloves. As natural latex contains contaminant proteins, that were found to cause allergic reactions in different people, the manufacturing of disposable gloves had been altered over the years to prevent contact with these proteins by adding an intrinsic polymer-coating. Thus, it was essential to use an inert solvent system that should keep the interior polymer-coating intact, allowing a reaction only with the amino acids on the surface rather than the latex proteins in the glove. The SEM analyses showed that HFE-7100 as opposed to petroleum ether, does not harm the inner coating, hence, providing the ideal solution to this challenging surface.

© 2017 Elsevier B.V. All rights reserved.

1. Introduction

Latex gloves are one of the most important exhibits that can connect a suspect to a crime scene, as they potentially contain both the fingerprints and the DNA profile of the person who had worn them. Over the years, the use of disposable Latex gloves has become quite popular among criminals, who wish to avoid leaving traces of fingermarks at crime scenes. Several approaches had been attempted in the past for developing latent fingermarks on the interior of Latex gloves. Among the different methods were: powders and powder suspensions, crystal violet, superglue fuming, SPR, MMD, and gel lifters [1]. Unfortunately, many of these standard methods yielded poor results [1–4]. Some casework studies had suggested that ninhydrin, which is usually used for porous surfaces, may also be applied for developing latent fingermarks on Latex gloves. These studies had used a heptane-based ninhydrin solution, reporting some potential for development [5–7]. However, n-alkanes, such as pentane, hexane and heptane, are known for their ability to readily dissolve Latex rubber [8], thus, making this ninhydrin formulation impractical for operational purposes due to the potential deterioration of the gloves. Another downside for using ninhydrin or other amino acid reagents for Latex gloves is the fact that natural latex rubber contains different contaminant proteins [9,10], which can also react with ninhydrin, hence leading to a high background staining and low resolution of the developed marks. Over the past three decades, the manufacturing processes of Latex gloves have been greatly improved, due to the realization that these proteins are also the main cause of hypoallergenic reactions in different people [9–14]. In order to achieve a low level of protein content and reduce their leaching to the interior surface, several technologies are available nowadays: (1) deproteinization by either enzymatic or chemical means; (2) chlorination; and (3) polymer coating [11]. The changes in the manufacturing of the gloves inevitably led to an

* Corresponding author.
E-mail address: michal.levin83@gmail.com (M. Levin-Elad).

https://doi.org/10.1016/j.forsciint.2017.09.015
0379-0738/© 2017 Elsevier B.V. All rights reserved.

alteration of the gloves structure, so they can no longer be treated as a mere non-porous surface. This study aimed to re-examine first whether disposable Latex gloves should be considered as porous or non-porous surfaces, and second, the connection between the structure of the gloves and the solvent used with development by ninhydrin.

2. Materials and methods

2.1. Substrates

The disposable gloves used for the experiments were of "PureShield™" powder-free Latex examination gloves (natural rubber latex, non-sterile). Twenty five random donors were selected and asked to put on gloves on both hands for 10 min. The process had been repeated once more so that each donor gave two sets of gloves (in total 100 gloves). The gloves were then taken off so the intrinsic side was now exterior, while randomly separating the gloves from each donor into two groups (total of 50 gloves in each group) for the two development methods — ninhydrin-HFE and Superglue followed by CV (fluorescent dyes were not used due to high degree of background staining of the latex surface). Each group was then randomly divided into 5 sub-groups (10 gloves in each group) to be developed after different times: (1) one hour; (2) one week; (3) two weeks; (4) three weeks; and (5) one month.

Most of the solvents were purchased from Bio-lab, unless stated otherwise. HFE-7100 was purchased from 3 M, crystal violet from Nile Chemicals, Wetwop™ from Kjell Carlsson, Liquidrin — Nin Plus Ultra™ from Mistral, Superglue (ethyl cyanoacrylate) was purchased from Alteco Chemical, and ninhydrin from Sigma Aldrich.

2.2. Development by ninhydrin-HFE

The ninhydrin solution contained 5 g of ninhydrin, 2 mL ethyl acetate, 5 mL acetic acid, 45 mL ethanol, 1 L HFE 7100. Development was carried out by dipping the gloves in the solution for approximately 10 s. As our in-house standard protocol for development by ninhydrin does not involve heating in a humidified chamber, but rather, natural drying in a fume hood for the required time for each exhibit, the gloves were left to dry in a fume-hood for 1–2 h before observing the fingermarks under white light.

2.3. Development by ninhydrin-petroleum ether (Liquidrin)

An attempt for development by the second formulation of ninhydrin solution (Liquidrin — Nin Plus Ultra™) was carried out by dipping the gloves in the solution for approximately 10 s, drying in a fume-hood and followed by observation under white light.

2.4. Development by superglue and crystal violet (CV)

Development was carried out by placing the gloves in a superglue cabinet (Misonix, CA-3000) for 15 min at 80% RH. The gloves were then dipped in a CV solution (3 g of CV in 1 L of ethanol) and allowed to dry in a fume hood for 1 h. The fingermarks were observed under white light.

2.5. Development by black powder suspension (Wetwop™)

Ten gloves from 10 different donors, which had been worn for 10 min, were developed by painting the inner side of the gloves

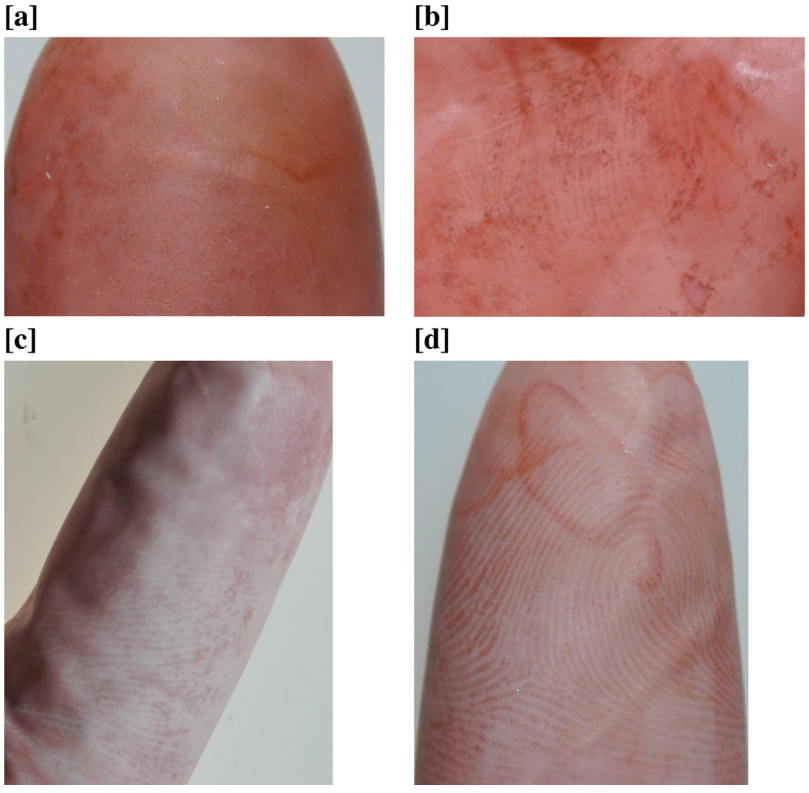

Fig. 1. An example for the assessment of the fingermarks (post development by ninhydrin-HFE): [a] grade 0 – no visible marks; [b] grade 1 – partial fingermarks unsuitable for comparison; [c] grade 2 – comparable fingermarks; [d] grade 3 – very high quality comparable fingermarks. The fingermarks were photographed using the Foster & Freeman DSC-5 system.

Download English Version:

https://daneshyari.com/en/article/4760241

Download Persian Version:

https://daneshyari.com/article/4760241

Daneshyari.com