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Fingerprint deposition on nitrocellulose and polyvinylidene difluoride membranes using alkaline phosphatase

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Summary

Dactyloscopy or fingerprint identification is a vital part of forensic evidence. Identification with fingerprints has been known since the finding of finger impressions on the clay surface of Babylonian legal contracts almost 4000 years ago. The skin on the fingers and palms appears as grooves and ridges when observed under a microscope. A unique fingerprint is produced by the patterns of these friction skin ridges. Visible fingerprints can be deposited on solid surfaces. Colored inks have been used to deposit ink on documents. Herein, we show that alkaline phosphatase can be used to transfer prints from fingers or palm to nitrocellulose or polyvinylidene difluoride membranes. The prints can be detected by using the nitro blue tetrazolium /5-bromo-4-chloro-3-indolyl phosphate method of detection.

Keywords

Dactyloscopy; Fingermarks; Fingerprints; Forensic science; Identification; Alkaline phosphatase

1. Introduction

Dactyloscopy or fingerprint identification, the singling out of individuals from indentations made by their fingers is the mainstay of forensic evidence even today. Identification with fingerprints has been known since the finding of finger impressions on the clay surface of Babylonian legal contracts almost 4000 years ago (1). Reports in the 19th century have suggested that impressions on clay/glass or bloody finger-marks could be used for the scientific identification of criminals.

Fingerprints form a vital part of forensic evidence and have been used in a number of criminal investigations and as a signature for preventing impersonation or repudiation of a

handwritten signature (2,3). Fingerprints are currently useful only when police or other security agencies obtain a positive match with those prints present on databases.

The skin on the fingers and palms appears as grooves and ridges when observed under a microscope. A unique fingerprint is produced by the patterns of these friction skin ridges (4).

Fingerprints are classified into 3 groups depending on the kind of surface on they occur and whether they are visible or not. Fingerprints found on hard surfaces are either latent (invisible) or patent (visible) prints, while that on soft surfaces like wet paint, fresh caulk, soap, wax etc are three-dimensional plastic prints. When paint, color, dirt, blood, or ink are transferred to from a thumb or a finger to a solid surface, it leads to the deposition of visible prints (<http://www.forensicsciencesimplified.org/prints/how.html>) (5–7). These three types of fingermarks can be encountered during criminal investigations.

Visible fingerprints can also be deposited on solid surfaces and maintained in a database for future identification purposes. Colored inks have been used to deposit ink on documents (2). Herein, we show that alkaline phosphatase can be used to transfer prints from fingers or palm to nitrocellulose. The prints can be detected by using the nitro blue tetrazolium /5-bromo-4-chloro-3-indolyl phosphate method of detection (8).

2. Materials

1. Nitrocellulose membrane.
2. Polyvinylidene difluoride.
3. Anti-human IgG horse radish peroxidase conjugate (HRP).
4. Anti-rabbit IgG alkaline phosphatase conjugate.
5. NBT/BCIP (Nitro blue tetrazolium/5-bromo-4-chloro-3-indolyl phosphate).

3. Methods

3.1. Depositing Fingerprint on Nitrocellulose/PVDF Membranes

1. Cut a nitrocellulose or PVDF membrane to the required size.
2. Remove the top flap covering the membrane.
3. Dilute alkaline phosphatase conjugate 1:500 with required volume of water into an appropriate container (*see* Note 1).
4. Dip finger, thumb or palm into the diluted conjugate.
5. Gently make the finger, thumb or palm impression on the membrane (*see* Notes 2, 3).
6. Let the membrane dry. It should dry within 5 min on nitrocellulose membrane.

3.2. Detection with NBT/BCIP

1. Once the impression of the thumb or finger is made on the membrane, allow it to dry. It should take less than two min for this.
2. There is no need to wash the dry membrane containing the finger, thumb or palm impression.
3. Add 10 mL of NBT/BCIP mixture and swish it over the membrane (*see* Note 4).
4. The fingerprint or palm print should appear in a few min. Wait till the development is complete and then rinse with deionized water.
5. Scan to save image (*see* Fig. 1, 2).

4. Notes

1. The conjugates were diluted 1:500 with water. If the fingerprint appears smudged, make one more finger, thumb or palm impression on the membrane using the residual alkaline phosphatase. No buffers were checked as diluent.
2. It takes much longer for the conjugate to dry on the PVDF membrane. It may be possible to make the conjugate to diffuse into the PVDF membrane. Diluting the conjugate in a 20 % methanol solution may work in making the alkaline phosphatase to diffuse. However, studies should be undertaken to find out the level of methanol that would be tolerated that allow the alkaline phosphatase to remain active.
3. Fingerprints obtained on PVDF with alkaline phosphatase appears fuzzy and smudged. Nitrocellulose would be the membrane of choice for depositing fingerprints with alkaline phosphatase.
4. The NBT/BCIP mixture is stored at 4 °C. It would accelerate the reaction if the required volume is brought to room temperature prior to adding to the membrane.

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Figure 1:
Thumbprint using alkaline phosphatase and detection with NBT/BCIP

Figure 2:
Index fingerprint using alkaline phosphatase and NBT/BCIP detection system