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# Possibility of Using Fingerprint Powders for Development of Old Fingerprints

(Kemungkinan Mengguna Serbuk Cap Jari dalam Pembangunan Kesan Cap Jari Lama)

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ABSTRACT

*The use of conventional fingerprint powder is the easiest and fastest method for fingerprint development. It is also the workhorse at the crime scene and an important method used in the laboratory. The objective of this study was to examine the difference in physical characteristics of the fingerprint after development using different fingerprint powders within a six-week period. The study compared the number of positives identifications of each 'minutiae' after application of black fingerprint powder and black magnetic fingerprint powder. The latent fingerprints from the donor were deposited on clean microscope slides. The following prints were applied after thirty minutes. Similar rules of pressure and length of deposition were made as much as possible. The slides were analyzed every week at similar intervals for six continuous weeks with black fingerprint powder and black magnetic fingerprint powder with specific indicator. The black fingerprint powder can be used for three weeks while black magnetic powder can up to fourth weeks. The results gave information on an effective time frame using both fingerprint powders for fingerprint development.*

*Keywords: Fingerprint development; fingerprint powders; forensic science; time estimation*

ABSTRAK

*Penggunaan serbuk cap jari adalah kaedah lama dan yang paling senang serta cepat dalam menimbulkan kesan cap jari. Kaedah ini adalah tunjang kepada setiap lapangan tempat kejadian jenayah dan teknik yang paling penting digunakan di dalam makmal. Objektif kajian ini adalah untuk mengenal pasti perbezaan dalam ciri-ciri fizikal cap jari setelah mengaplikasi kaedah ini untuk menimbulkan kesan cap jari dalam tempoh enam minggu. Kajian ini membezakan jumlah jalur atau* minutiae *yang boleh dicamkan sebagai positif kepada pengenalan individu setelah mengaplikasi serbuk cap jari hitam dan serbuk magnetik cap jari hitam. Cap jari yang diambil dilekatkan pada permukaan slaid mikroskop yang bersih. Sampel slaid ini dianalisis menggunakan penunjuk yang sesuai setiap minggu pada selang masa yang sama selama enam minggu berturut-turut menggunakan serbuk cap jari hitam dan serbuk magnet cap jari hitam. Serbuk cap jari hitam dapat digunakan selama tiga minggu manakala serbuk magnet cap jari hitam pula dapat digunakan selama sehingga empat minggu. Hasil keputusan ini dapat memberikan gambaran tempoh masa yang sesuai untuk menggunakan serbuk cap jari dalam menimbulkan kesan cap jari.*

*Kata kunci: Mengenal pasti masa; penimbulan cap jari; sains forensik; serbuk cap jari*

## INTRODUCTION

Fingerprints found at crimes scene are important as valuable evidence. Fingerprint identification, can be referred to as individualization, identifies individualized patterns that can be used to confirm or reject the association of a suspect with objects found at a crime scene. In addition, fingerprints are unique to every individual and are formed in the human fetus before birth. It does not change throughout one's life unless damage occurs to the dermal of the finger skin layer (Han et al. 2005; Nayak et al. 2010). The patterns of fingerprints become fixed when a person is about 14 years or older (Hsieh et al. 2005). Therefore, no two fingers are found to have identical prints even identical twins which share the same DNA profile (Nithin et al. 2009). Furthermore, judges put higher value on fingerprints than other physical evidence, proving that they need to be considered extremely important evidence.

A latent print either from the finger, palm or even from the sole are left at the crime scene resulting from contact that leaves residue from the skin when an item is touched (Cramer & Glass 2008). Fingerprints are formed from the dermal ridges that exist on our fingers. The dermal ridges are lined with numerous sweat pores including eccrine and apocrine glands that exude sweat, which moistens the ridges. The sebaceous glands associated with hair follicles produce oily residues that fingers pick up from other parts of the body. This residue leaves deposits on items with which the person may come into contact and is usually invisible to the naked eye. These deposits are called latent prints. The composition of fingerprints allows us to use a method to discover the latent print on different surfaces and conditions. Choi et al. (2006) found that the effectiveness of the powder adheres to the ridges depends on the size and shape of particles. The small and

fine particles generally adheres more easily than large and coarse particles to the ridges. Most formulations of conventional fingerprint powders are composed either of very fine, rounded particles (about 1 μm) or fine flake particles (about 10 μm).

According to Wertheim (2003), fingerprint age determination has traditionally been approached in three ways: (1) the physical appearance of the latent print, either before or after development, (2) the use of experiments that help to establish the effects of environmental factors over a given period of time and (3) the measurement of chemical changes in the constituents of latent print residue. An examiner may infer that a latent print is new based on how the powder adheres to the ridges, or on the clarity of the ridge detail. A 1975 study on the effects of temperature and humidity on latent print deposits concluded that the clarity of a developed print is primarily related to the original latent print quality and it was not possible to determine that a fingerprint is new or several weeks old by observing how the print develops when the dusting powder is applied.

The use of fingerprint powders as a developing technique dates back to the early nineteenth century. The use of black chemical and magnetic powder for old fingerprint enhancement had been questioned as it is usually used for latent or new fingerprint. Some examiners believe that the physical appearance of the latent print upon development with powder is correlated with the age of print (Azoury et al. 2004). These examiners believe that the appearance of high quality prints and the rate of development are associated with the prints' freshness. Powder dusting is a method of physical enhancement that relies on the mechanical adherence of fingerprint powder to the moisture and oily components of skin ridge deposits left at the surface. Although there are other methods newly discovered with the latest techniques and knowledge, the use of conventional fingerprint powder still remains useful especially at the crime scene and even at the crime laboratory. Powdering is relatively simple and inexpensive method on nonporous surfaces. In addition, the application of powder to latent prints gives an instantly apparent print.

Examiner may infer that a latent print is new based on how the powder adheres to the ridges, or on the clarity of the ridge detail. Many studies showed that black powder can only be used for new fingerprint and some studies showed that it can be used for almost 8 month old fingerprints. According to Moenssens (1971), powder is usually effective within the first week after placing the latents. However study in Israel at Jerusalem and Haifa by Azoury et al. (2004) showed that high quality fingerprints could easily developed with magnetic fingerprint powder even months after being deposited. Therefore, the purpose of the present study was to examine the duration on different types of fingerprint powder such as black fingerprint powder and black magnetic fingerprint powder on microscope slides for enhancement of fingerprints left over six time periods (i.e. one week, two weeks, three weeks, four weeks, five weeks and six weeks).

## Materials and Methods

Two different powders were used in this study: black fingerprint powder and black magnetic fingerprint powder. Both were purchased from Lightning Powder Company Inc. These powders were selected because of their widespread use and they easily be applied in fingerprint development.

Comparison experiments were performed on glass microscope slides from Fisher Scientific Premium Microscope Slides Plain, made of Swiss glass, Catalog No. 12-544-1, 7.68 cm × 2.56 cm × 1 mm, approximately ½ gross. For each comparison, the photographs are taken with a Sony Digital Still Camera Model No. DSC-F717 with attached Carl Zeiss Vario Sonnar, 10 × precision digital zoom cybershot, 5.0 mega pixels. The images were then edited by Windows Media Player for better contrast and identification.

### Preparation of Fingerprints Deposition

The study was conducted at Washington DC in October during fall season. All fingerprint samples were taken from a single donor. The fingerprints from the donor were deposited on clean microscope slides. The hand was cleaned with water and soap and allowed to dry for thirty minutes before deposition. The latent impression was made by pressing the thumb on the surface of the slides. A second print was applied after thirty minutes. Similar rules of pressure and length of deposition were made as much as possible. The slides were kept at room temperature facing the ceiling, expose to dust and air conditioning. The slides were analyzed every week at similar intervals for six continuous weeks with black fingerprint powder and black magnetic fingerprint powder. Photographs were taken to show the comparison for all single microscope slides.

The prints that developed were evaluated and were assigned a score between 0-3 according to the quality of prints:

0 = No ridge details were observed.
1 = Few ridge details were observed (between 1 and 8 positive points).
2 = Enough ridge details were observed to allow identification (between 9 and 14 positive points).
3 = Very good fingerprint quality (AFIS) (more than 15 positive points).

(a)

(b)

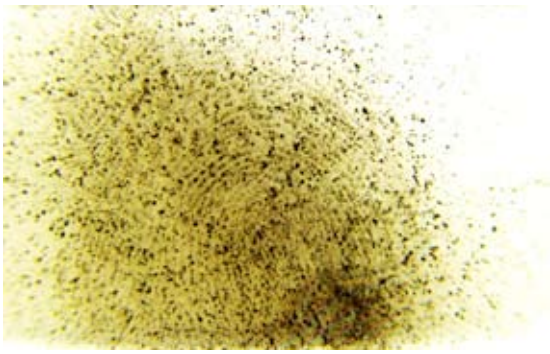
FIGURE 1. The fingerprints developed by black fingerprint powder (a) and black magnetic fingerprint powder (b) for the 1st week.

(a)

(b)

FIGURE. 2. The fingerprints developed by black fingerprint powder (a) and black magnetic fingerprint powder (b) for the 2nd week.

(a)



(b)

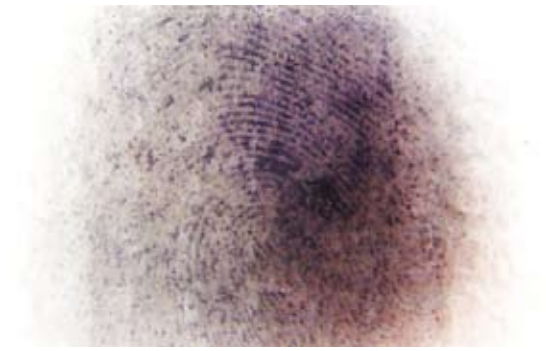


FIGURE 3. The fingerprints developed by black fingerprint powder (a) and black magnetic fingerprint powder (b) for the 3rd week.

(a)

(b)

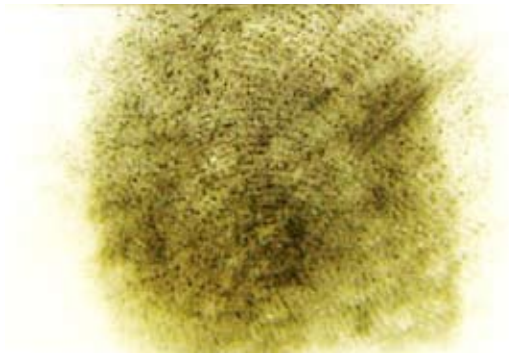


FIGURE 4. The fingerprints developed by black fingerprint powder (a) and black magnetic fingerprint powder (b) for the 4th week.

(a)

(b)

FIGURE 5. The fingerprints developed by black fingerprint powder (a) and black magnetic fingerprint powder (b) for the 5th week.

(a)

(b)

FIGURE 6. The fingerprints developed by black fingerprint powder (a) and black magnetic fingerprint powder (b) for the 6th week.

## RESULTS AND DISCUSSION

There was no attempt in this study to estimate and determine the fingerprint aged. In addition, parameters such as different conditions and other more sensitive and newer techniques (cyanoacrylate fuming) were not tested, as it is difficult to examine so many parameters at once. The results of the experiments are presented in Table 1.

Problems that were encountered include over-powdering and poor quality of photographs. Both are related to the skill of the examiners. Examiners inexperienced in examining fingerprints may not recognize the point of optimal development (sufficient ridge detail and contrast of the ridge detail versus the substrate) and may over-powder the print. However, the powdering photographic techniques improved each time the experiment was performed due to experience.

TABLE 1. Score on the identifiable fingerprints developed by black fingerprint powder and black magnetic fingerprint powder at various periods of time

| No. | Week | Fingerprint Score | |
|---|---|---|---|
| | | Black fingerprint powder | Black magnetic fingerprint powder |
| 1 | First | 3 | 3 |
| 2 | Second | 3 | 3 |
| 3 | Third | 2 | 3 |
| 4 | Fourth | 1 | 2 |
| 5 | Fifth | 0 | 1 |
| 6 | Six | 0 | 0 |

In this experiment, results showed different techniques and time for fingerprint development. An inverse relationship was found between positive points of identification over time. Different techniques for fingerprint development may contribute to different results. Therefore, it is important to apply procedures using both black fingerprint powder and black magnetic fingerprint powder on fingerprints at the crime scene. The examiner believes that the appearance of high quality with score 2 and 3 are associated with techniques, the skill of the examiner and the age of the fingerprints. Both black fingerprint powder and black magnetic fingerprint worked well in the first and second week. However as time passed, black fingerprint powder only is useful for latent prints up to the 3rd week, while black magnetic fingerprint powder works fairly well for up to the 4th continuous week. This may be due to the chemical structure of both powders that may result in the disposition of powders to the ridges. Fine particles may easily adhere to the ridges and give better results when compared with coarse particles. According to Baniuk (1990) knowing the mechanism of fingerprints formation is an indispensable factor to support an opinion concerning the age of fingerprints.

This study differs from the experiments done by Azoury et al. (2004) in the application in different places and under different weather condition. The study done by the researcher in Israel developed under higher humidity, and the fingerprints were well-preserved on the top shelf inside a cupboard while the doors were opened and closed. In this study, the fingerprints were left on a table in an air-conditioned room, clearly exposed to dust. Higher humidity and temperature leads to a person producing more sweat, and the prints left on touched surface are well-defined in comparison to a person in a cold, dry place. Therefore, the examiner assumes that there may be high correlation among humidity, temperature and storage condition on the quality of fingerprints. More parameters should be studied to further explore why different places may produce different results on fingerprints development.

There are many factors affecting the condition and characteristics of fingerprints. However, the combined effects may never be fully understood. These factors include subject factors such as stress, metabolism, diet, health, age, sex, occupation, quantity and quality of fingerprint contamination (Wertheim 2003). In addition, transfer conditions may also contribute to the fingerprint condition such as the surface texture, physio-chemical structure, curvature, temperature, temperature difference, pressure and contact time. Other environmental factors include temperature, humidity, ultraviolet and other radiation, dust, precipitation, condensation, friction (handling or other natural movement), air circulation and atmospheric contamination may also effecting the fingerprints (Wertheim 2003).

To improve the reliability of this project's results, other variable must be held constant. In practice, although the above method was carefully executed, it is virtually impossible to achieve such conditions as there are many different unknown or unidentifiable factors. More research can be done to optimize each fingerprint techniques and improve the quality of fingerprints being developed.

## Conclusion

Two parameters were study in this experiment; time and techniques. Results proved that fingerprint development via black magnetic fingerprint powder was superior as it produced well developed fingerprints after the 4th week, compared with black fingerprint powder which can only be used for up to 3 weeks. Furthermore, the condition of fingerprints deteriorates over time. The longer a fingerprint is left, the less likely it is that a positive individual identification can be made. In addition, the use of fine particles may improve fingerprints development. This may open new research that can be done on the use of fine nanoparticles such as titanium dioxide to improve contrast and visualization of latent fingerprints. These are issues that should be addressed before any development techniques are applied to the actual work either at a crime scene or in a crime laboratory.

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