Asian Journal of Chemistry; Vol. 30, No. 12 (2018), 2615-2620

ASIAN JOURNAL OF CHEMISTRY

https://doi.org/10.14233/ajchem.2018.21378

Comparison between Latent Fingerprint Identification using Black Powder and Cyanoacrylate Glue

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Received: 9 April 2018; *Accepted*: 3 October 2018; *Published online*: 31 October 2018; AJC-19120

The purpose of this study was to compare the latent fingerprint identification using black powder and cyanoacrylates glue. This study was conducted on 30 undergraduate students in year 2013 of Chemistry Education Department, Syiah Kuala University. The methodology used to identify latent fingerprints was the preparation of tools and materials, carry out the work and verification procedures. The results found that the latent fingerprint identification using black powder could be seen clearly (contrast) using black powder compared with cyanoacrylates glue.

Keywords: Fingerprint, Black powder, Cyanoacrylates glue.

INTRODUCTION

Analysis and fingerprint identification is the most important component in the activities of criminal investigation and forensic science. Fingerprints are unique and permanent. The purpose of the fingerprint is the trace or mark left on an object by one's fingertips. First countries to use the fingerprint was China, which was evident from the record of the Qin Dynasty (221-206 BC) to prove the theft investigation. Fingerprints become a very important thing for being a reliable manner for personal identification. In addition there are several reasons fingerprints used in forensic science, namely fingerprints provide an accuracy of identification of crime throughout the world for over 100 years, founded the first by a professional forensic organization International Association of Identification (IAI) in 1915, and is the best proof common for forensic worldwide.

Fingerprints are the only critical examination during the criminal investigation. Fingerprints can be found in solid objects including the human body. There are generally three types of fingerprints found at the crime [1], namely plastic fingerprints, visible fingerprint/patent and invisible fingerprints/latent as shown in Fig. 1.

Invisible fingerprints or latent fingerprints require special examination because it cannot be seen by naked eye. Latent fingerprints can be found on more surface either smooth or rough, porous (paper, clothing or wood) or non-porous (metal, glass, or plastic). According to Yamashita and Mike [2], the word latent means hidden or invisible. Fingerprint latent fingerprint was not detected until require physical or chemical processes to enhance the fingerprint residue. Furthermore, Pahade and Shivpoojan [1] stated that latent fingerprint was composed of water, amino acids, oils and some other substances in the human body.

According to Shrivastava *et al*. [3], a latent fingerprint is a fingerprint that cannot be seen with the naked eye so that the finger is known as the "hidden or invisible". Latent fingerprint formed from the sweat glands of the body and can be found on the entire surface where the perpetrator did touch contact with the object. Human-like facial characteristics tend to change with age will change but fingerprints will not change.

A variety of techniques use powder and chemicals to develop latent fingerprints. Chemicals and powders can be used to develop latent fingerprints on contact or 'touch" surfaces, such as hard and non-absorbent surfaces and soft and porous surfaces. The techniques range from chemical methods such as powders and iodine fuming to the use of laser light. The black powder, composed basically of black carbon or charcoal, is applied to white or light coloured surfaces. On the other hand, super glue fuming is a technique for visualizing latent fingerprints non-porous surfaces by exposing them to cyanoacrylate vapors; named

Fig. 1. Types of fingerprints: (a) plastic fingerprint; (b) patent fingerprint; (c) latent

for the commercial product super glue. One latent fingerprint is identified by sprinkling black powder, one of which activated carbon [4]. Black powder is a powder that is used as a physical method is applied to the fingerprint brush area [3]. Furthermore, black powder is a powder particles applied on non-porous surfaces, such as activated carbon [2]. Black powder has been used to identify latent fingerprints since the 19th century. The reason the use of black powder is because it is stable and easily applied to a variety of porous or non-porous objects. Black powder is used for the detection of physical, how to apply it to the area to be tested using a brush so that the dark colour prints can be observed [5]. In addition to black powder, there are other materials that can be used for detection of latent fingerprints is with glue made from cyanoacrylates, such as brand of Alteco.

Cyanoacrylates is one of the synthetic glue which quickly hardens when in contact with a weak base such as water and blood. Cyanoacrylates glue is a liquid that can be mixed with lipoid, oil intermediary contrast [6]. Cyanoacrylates is one of the ingredients of super glue that is used to visualize latent fingerprints [2]. Furthermore, cyanoacrylates is an ester when in contact with organic material of a fingerprint will form a white solid. This method was first used by the Criminal Identification Division of Japanese National Police in 1978 in the development of latent fingerprints. Cyanoacrylates used to detect fingerprints because it can react with amino acids, fatty acids, and proteins in the fingerprint as well as possible with the air so as to make fingerprints visible. Cyanoacrylates glue is used to identify the fingerprint by applying on the surface of aluminium objects stored in a sealed container. When closed cyanoacrylates will evaporate and stick to the surface of the object contained a fingerprint so that it can be easily identified [7]. The black powder was effective to identify fingerprints and commonly used in a variety of investigations [6].

Rozman *et al*. [8] found that the powder dusting was the basic and least complicated method for the recovery of fingerprints from many surfaces, from human skin as well. In this study, Swedish black powder was used for the recovery of finger marks and white fingerprint gelatine was used for lifting. This study has shown that the best results were achieved for finger marks recovered within one and three hours after fingerprints were deposited onto human skin surfaces. Useful finger marks were recovered from chest, ulna, femur, shin and area of ankle [8]. Dominick and Laing reported [9] compared the effectiveness of six different enhancement methods on six different sizes of brass cartridges. One sebaceous fingerprint was deposited onto 25 of each size of cartridge to enable a statistical evaluation of the enhancement methods for each cartridge size to be undertaken. The enhancement methods compared were cyanoacrylate fuming followed by brilliant yellow dye staining, cyanoacrylate fuming followed by gun blue followed by brilliant yellow dye, gun blue only, cyanoacrylate fuming followed by palladium deposition, palladium deposition only, and powder suspension. Two techniques provided the best results: (1) cyanoacrylate fuming followed by gun blue followed by brilliant yellow dye and (2) cyanoacrylate fuming followed by palladium deposition [9]. A cyanoacrylate fuming fingerprint processing method was optimized for the use of four alkyl cyanoacrylates *e.g.*, methyl, ethyl, *n*-butyl and 2-octyl. Since the adopted microstructures vary from one alkyl cyanoacrylate to another, the effectiveness of these dyes may depend on the cyanoacrylate used [10]. Based on previous studies, therefore the purpose of this study was to compare the latent fingerprint identification using black powder and cyanoacrylates glue.

EXPERIMENTAL

The materials used were plastic cups, scissors, clear tape, brush, food containers, cyanoacrylate glue, charcoal, aluminium foil, paper white and compact disk (CD) and warm water.

Samples: From the total 65 students of Chemistry Education Department, Syiah Kuala University of year 2013, 30 students were selected ramdomly for sample collection.

Procedure: The procedures for latent fingerprint identification were done using with black powder and cyanoacrylates.

The procedure of latent fingerprints using black powder was as follows: (a) Plastic cups were taken for fingerprints, (b) brush applied to charcoal that had been mashed and then applied on the plastic cups that contained a fingerprint, (c) fingerprints were visible retrieved using clear tape, (d) fingerprints on clear tape were affixed to the white paper and (e) observed fingerprint was developed.

The procedures of latent fingerprints identification using cyanoacrylate glue was as follows: (a) in the form of two cup using aluminium foil, (b) first bowl was filled with warm water, while the second cup was filled with cyanoacrylate glue, (c) the cup was inserted into a container of food that had entered a CD before hand. The container was sealed so that air was not out, (d) allowed to stand for 15 min and then observed the formed fingerprint.

RESULTS AND DISCUSSION

Black powder (activated charcoal) use on the latent fingerprint identification was usually done by the method of sowing powder (dusting) which is the simplest method. Fingerprints

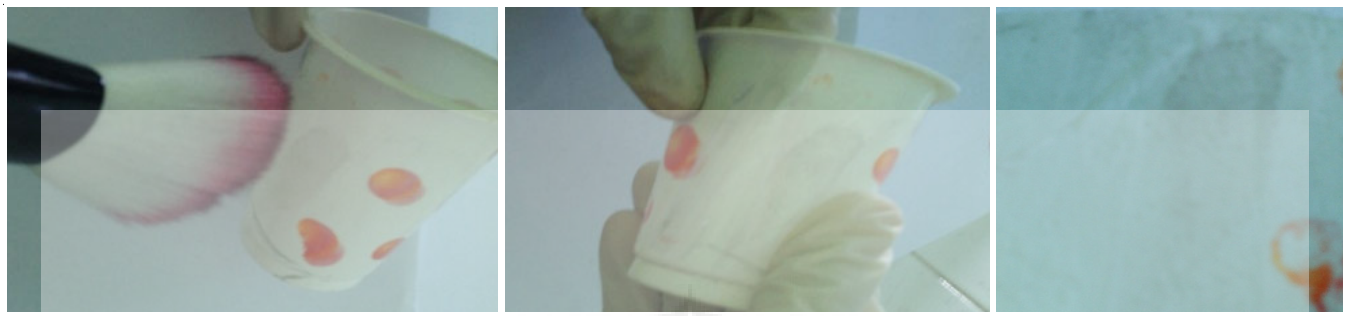


Fig. 2. Result of latent fingerprint identification using black powder

were attached to the surface of plastic cups in a sprinkle powdered charcoal using a makeup brush so that the fingerprints found on the plastic cups clearly visible. Insulation was aimed to simplify the process of observation of visible fingerprints. The result of latent fingerprint identification using black powder can be seen in Fig. 2. In addition, latent fingerprints could be identified as white solid using glue that made from cyanoacrylates [7].

Chemical aspects of cyanoacrylate having a high affinity or strong attraction to amino acids, fatty acids and proteins in a fingerprint and the vapours of the super glue adhere to these components. Latent fingerprints are composed of sweat, amino acids, fatty acids, proteins, potassium and sodium. Therefore, cyanoacrylates making the fingerprints can be clearly seen. When identifying fingerprints, cyanoacrylates glue was applied to the surface of aluminium foil which was stored in a sealed container. This method was also used in warm water which aimed to simplify the process of evaporation of cyanoacrylates so that the fingerprints were attached to the surface of CD can be easily observed. The more cyanoacrylates used, the more clearly visible fingerprints. Fig. 3 shows the results of latent fingerprint identification (which was not visible to naked human eye) using cyanoacrylates glue. It was reacted with the substance glue secretions (sweat glands) in the form of a white solid fingerprints. Based on identifications, the fingerprint patterns of 30 samples are shown in Fig. 4.

Fig. 3. Results of latent fingerprint identification using cyanoacrylates glue

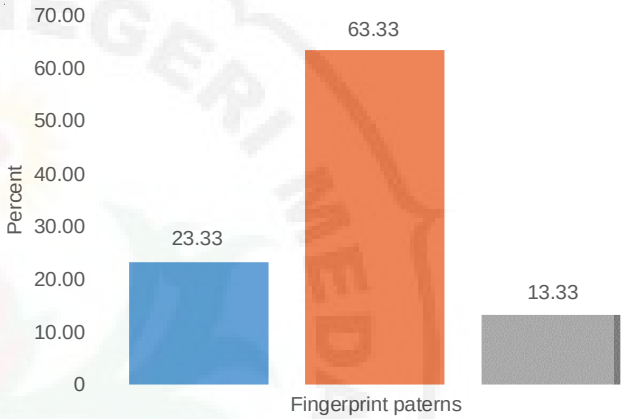


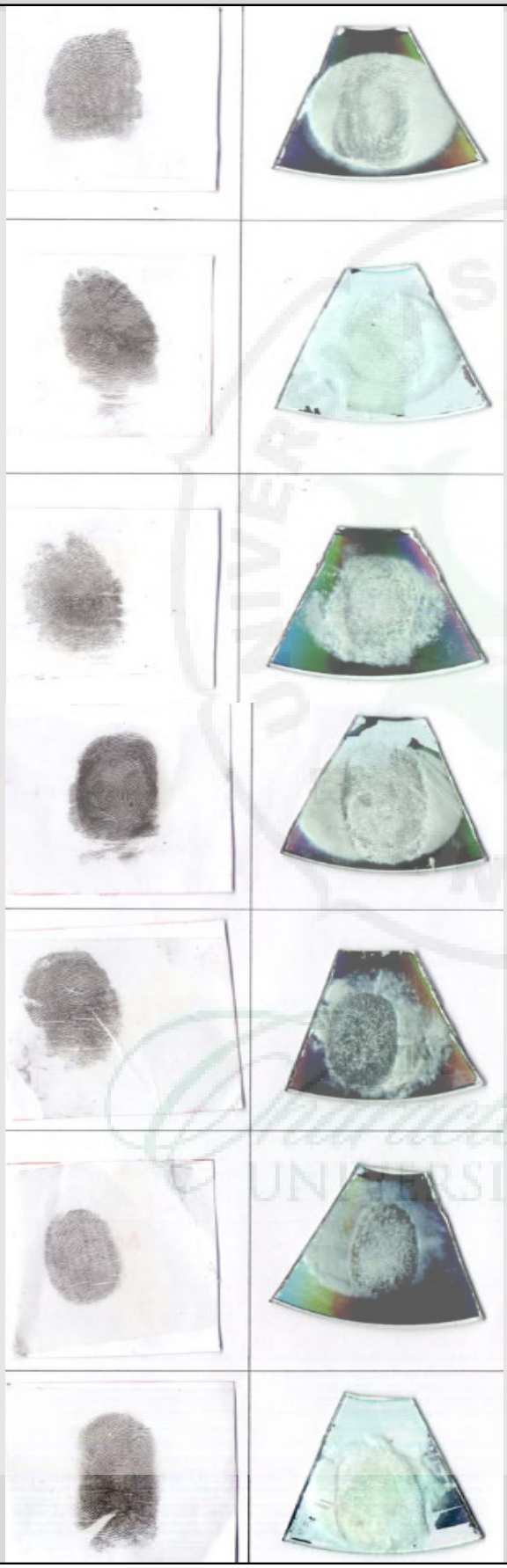
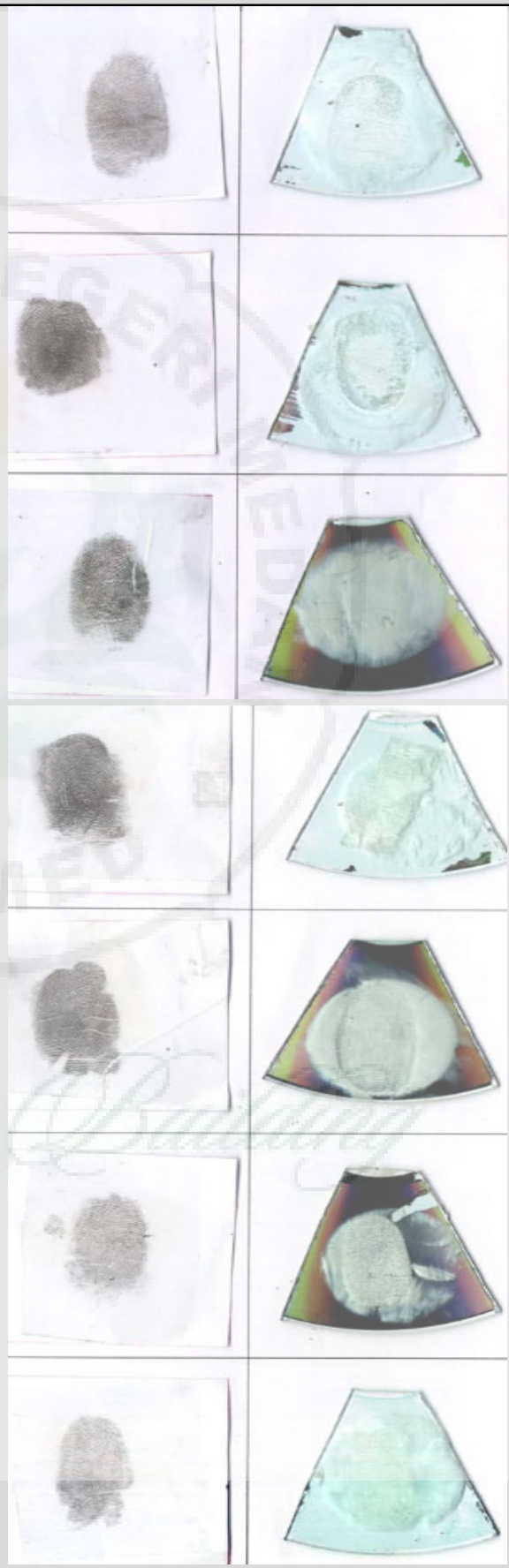
Fig. 4. Fingerprint patterns of samples

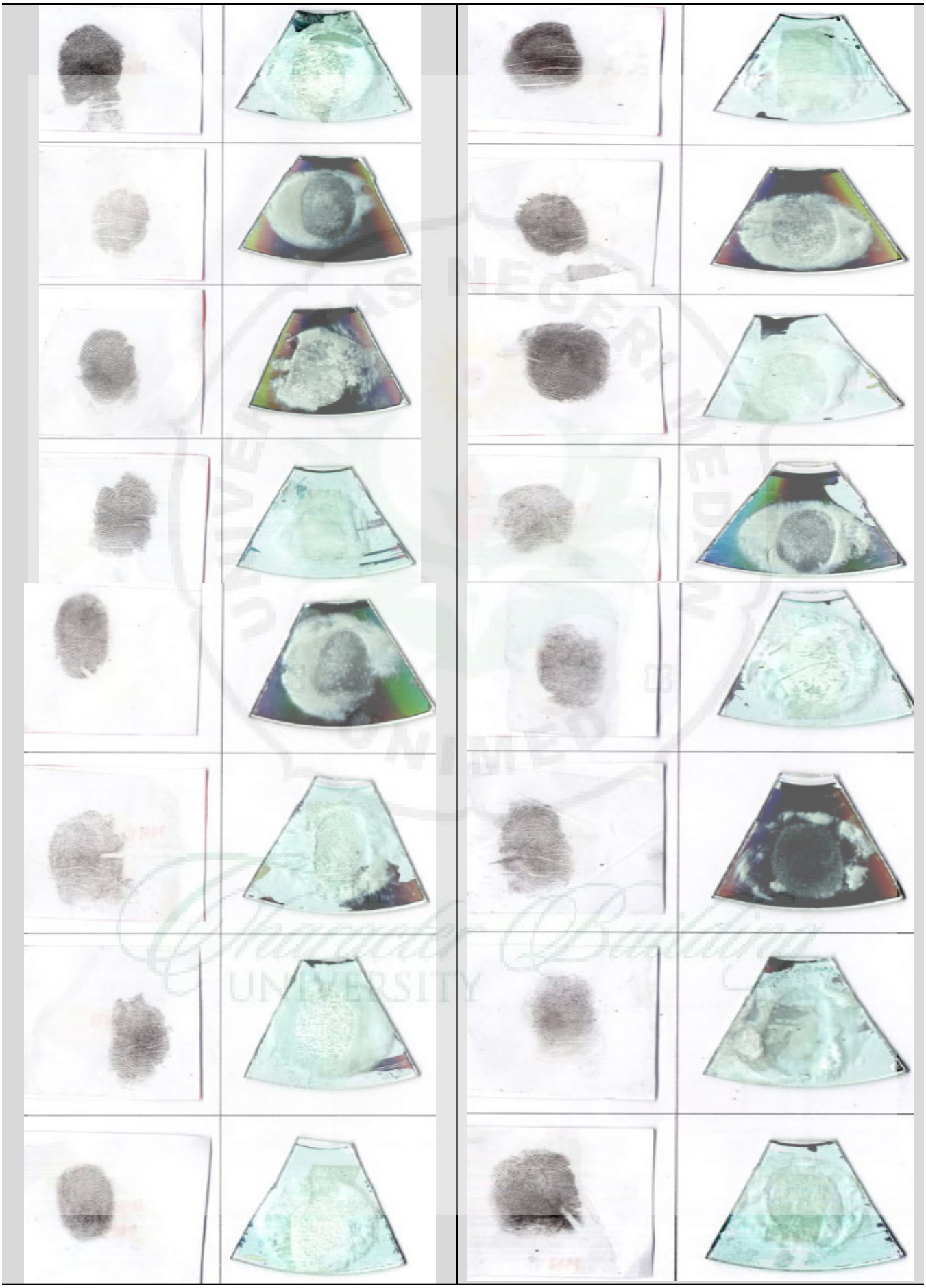
The results showed that the fingerprint patterns of samples were found to be 23.33 % of plain whorl (blue bar) 63.33 % were radial loops patterns (orange bar) and 13.33 % were ulnar loop patterns (grey bar). The fingerprints were actually formed from material on the fingers that was pressed upon a surface: (a) prints were also formed from oils secreted by the fingers, (b) through the pores, perspiration was discharged and deposited on the surface of skin, and (c) once the finger touches a surface, perspiration, along with oils that may have been picked up by touching the hairy portion of the body, is transferred onto that surface.

The comparison results of latent fingerprints identification is presented in Table-1, which shows that the identification of latent prints using black powder was more noticeable than the cyanoacrylate glue. This could be explained that during the evaporation process was not perfect, fingerprints used cyanoacrylate glue did not look so obvious. This fact was in accordance as stated by Ahmad and Afizah [11] that cyanoacrylates liquid would be evaporated into vapour form when reacted with sweat and oil glands.

Latent fingerprint left his mark on a surface that was touched or held in check. It might be due to the finger excrete secretions (sweat and oil) produced by sweat glands. The secretion of substances was basically the electrolyte solution or salt mixed with urea and other fats and other organic compounds. This fingerprint could not always be seen clearly visually. To create a fingerprint in more contrast then use chemicals that would be reacted with the secretion of substances such as black powder and cyanoacrylate glue. Similar findings were supported by Omar and Ellsworth [12]. They examined the difference in physical characteristics of the fingerprint after development using diffe-

TABLE-1
COMPARISON BETWEEN OBSERVED LATENT FINGERPRINT IDENTIFICATION FROM 30 STUDENTS

Black powder	Cyanoacrylates glue	Black powder	Cyanoacrylates glue
			



rent 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 0.5 h. Similar rules of pressure and length of deposition were made as much as possible.

The slides were analyzed every week at similar intervals for 6 continuous weeks with black fingerprint powder and black magnetic fingerprint powder with specific indicator. The black fingerprint powder can be used for 3 weeks while black magnetic powder can upto 4th weeks.

In addition, latent fingerprint identification could be seen more enhanced using black powder compared with cyanoacrylate glue. It also might be due the type of surface. As described on the procedures that the thumb fingerprints were put on paper and compact disk (CD) surfaces. This findings were related to Sudjaroen and Thongthienchai [13], which studied the quality of latent fingerprint on different types of screen protective films by using black powder method in developing latent fingerprints. The fingerprints were performed by 10 volunteers whose fingers (right index, right thumb, left index and left thumb) were stubbing at different types of screen protective films and subsequently latent fingerprints were developed by brushing with black powder. It has been found that the quality of latent fingerprints developed between a clear and a matte surface of screen protective films showed a significant difference (sig. > 0.05), whereas the coat and non-coat with anti-fingerprint chemical revealed a non-significant difference (sig. < 0.05) in their number of minute points.

Latent fingerprints identification using black powder was found to be clearer in this study were also might be due to the condition of black powder which was categorized as small particle reagents (SPR). It was related to the study reported by Pahade & Shivpoojan [1] that SPR could be important method for visualization of latent fingerprints on porous and non-porous, wet and dry surfaces. The SPR solution had been successfully used to develop latent prints on paper, cardboard, metal, rusty metal, rocks, concrete, plastic, vinyl, wood and glass. Similarly, latent prints had been developed on sticky surfaces, such as soda canes and candy wrappers. The aqueous suspension of powder was sensitive to the sebaceous components of the latent fingerprints. Small particle was most well-known for its ability to develop latent prints on wet surfaces.

Related to porous, the findings of this study were strongly supported the similar study conducted by Rohatgi and Kapoor [14]. This study also found that the latent fingerprints present on majority of the surfaces examined can be successfully developed with all the employed food products. It has been observed that most clear and visible prints were developed on almost all porous surfaces such as currency note, card sheet, plain paper, glossy magazine cover. While non-porous surfaces such as aluminum foil, steel (spoon) and plastic sheet showed very clear decipherable prints with all powders.

Present results indicated that the fingerprint identification using black powder was better than using cyanoacrylate might be due to the type of method. Powder method was found to be better than other, such as glue. Explanation of this study was supported by Garg *et al*. [15]. They found that the powder method using turmeric powder gave very clear results in majority of the surfaces. The latent fingerprints present on majority of the surfaces examined had been successfully developed. The comparative evaluation of different surfaces with this powder gave better results on contrast surfaces than the others examined. The development of latent fingerprints present on surfaces like, simple paper, bond paper, thermal paper, aluminum foil, transparency sheet, wood (sun micaglossy), plastic sheet, painted steel, top and writing surface of the CD could be successfully done and gives clear ridges as is evident from the figures. The latent prints could be developed with turmeric powder on the top as well as writing surface of CD. It was further interesting to note that the latent prints after development with turmeric powder on writing surface of compact disk did not destroy the data contained therein and can be further used.

Conclusion

Analysis and fingerprint identification were the most important component in the activities of criminal investigation and forensic science. In purpose to make these fingerprints more contrast, the use of chemicals react with the secretion of substances such as black powder and cyanoacrylates glue. Latent fingerprint identification could be seen more clearly (contrast) using black powder as compared to cyanoacrylates glue. Some factors those could be explained this findings were: (a) chemical aspects of reagents used, (b) type of surface to put the fingerprint (porous or non-porous), and (c) conditions of chemicals (small particles or sticky).

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this article.

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