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Development of Eco-Friendly Fingerprint Visualization using Herb

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This study was aimed to develop an environmental-friendly fingerprint visualization using turmeric herb. The turmeric powder size was in the range of 60-200 mesh. The dusting method was done by applying turmeric powder to glass surface, aluminum foil, transparent plastic, plastic cups and compact disk (CD) surfaces that have sebum content from fingerprint samples. This study was also compared with the small particle reagent (SPR) of ninhydrin. The SPR method was done by spraying ninhydrin solution on A4 white paper and doorslag paper. The results of this study indicated that form of fingerprint obtained has the following pattern: radial loop (16.6 %), ulnar loop (63.3 %), tented arch (1.6 %), twinted loop (1.6 %) and plain whorl (16.6 %). The results showed that the turmeric powder dusting method gave a low contrast with yellow colour while ninhydrin SPR provides high contrast with Ruhemann's purple.

Keywords: Turmeric, Dusting Method, Small particle reagent, Ninhydrin.

INTRODUCTION

Fingerprints in forensic science generally are used to identify suspects, victims and people who touch a surface at the crime scene. The science of fingerprint identification is more desirable in forensic chemistry based on the fact that fingerprints are unique, individual prints remain unchanged, and no two individuals have exactly the same pattern. The impression of the fingerprint comes from the friction ridge, which is the arch, loop and whorls, which cover the surface of the finger and sweat [1].

Several studies of visible and latent fingerprints have been carried out. Deoxyribose nucleic acid (DNA) extracts from adhesive tapes for fingerprint development [2]. In addition, latent fingerprints were found in short random repeats (STR) [3]. Similarly, for DNA collection from relatively hairless areas of the body using Scotch tape ®3M No. 5414. DNA was then recovered using 3M "Scotch" No. 5414 to collect cells from clothing [4,5]. Fingerprinting is a valuable type of physical evidence in identification. In general, three fingerprint traces can be found in a crime scene are visible (or printed patterns), impressions (or plastic prints) and latent prints. Latent print outs are not visible to the ordinary eye and therefore require some development tools or enhancements for their visualization.

New techniques have also been developed for latent fingerprint detection but simple fingerprint detection to observe latent prints was a powder method. If the powder was sprinkled over the area affected by the fingerprint, then the powder sticks to the oil, sweat or other material left in the fingerprint. This powder technique has been used since the early 1900s. During this period, many fingerprint powder formulations have been used, with each formula consisting of dye for contrast and resin material for good adhesion [5]. Hundreds of fingerprint powder formulae have been developed so far.

Some of the ingredients used as a way to find out fingerprints are chemicals which are potentially toxic and endanger health. To overcome this, research was carried out using natural powder as a development of latent fingerprints that were easily obtained, non-toxic and had several beneficial properties, such as turmeric powder [6,7]. The method used involved the spray of turmeric powder on various surfaces and the results provided print contrast, which was good as the development of latent fingerprints.

Turmeric (*Curcuma domestica* Val.) is a perennial herbaceous rhizomatus plant of ginger/zingiberaceae family. Turmeric has been cultivated in India since ancient times. The rhizomes that produce turmeric are short roots with blunt rhizomes. The product is basically known as 1,7-*bis*-(4-hydroxy-3-methoxy-

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phenyl)hepta-1,6-diene-3,5-dione (also known as curcumin) and also dimethoxy and *bis*-dimethoxy derivatives. The function of curcumin is also applied a supplement to colour foods [8].

Another method used for fingerprint visualization is known as small particle reagent (SPR) method using ninhydrin solution. Research using ninhydrin solution is a chemical reagent for the development of latent fingerprints on porous surfaces. Detection based on the ninhydrin reaction will form a coloured compound, Ruhemann's purple, whereas the introduction of ninhydrin treatment for the visualization of latent fingerprints on porous surfaces revolutionizes the forensic approach in fingerprint examination [9,10]. This ninhydrin solution can increase the sensitivity of latent fingerprints especially to amino acids [11-13]. Based on the above background, a research was conducted to develop the dusting method using turmeric powder as visualization of latent fingerprints on porous and non-porous surfaces. Then the comparison of the two methods was carried out as visualization of latent fingerprints on different surfaces.

EXPERIMENTAL

Fresh turmeric (1 kg) of highest purity was procured from the local market, washed, peeled and then sliced into small pieces with a thickness of 1-2 mm. Then dried under sunlight for 2 days and blended until smooth, could also be dried using an oven type rack at 60 ºC for 12 h. After that turmeric powder was sieved with 60, 80, 100 and 200 mesh sieve sizes, then placed into a powder container.

Preparation of ninhydrin solution (0.6 %): A 0.5 g of ninhydrin were dissolved in acetone, then diluted to 100 mL and place in a spray bottle.

Latent fingerprint preparation: Fingerprint preparation was done by preparing fingerprints for each porous surface (A4 white paper and doorslag paper) and non-porous surfaces (glass preparation, aluminum foil, transparent plastic, plastic cups and CD surfaces). Latent fingerprinting was done by means of plain impression, the fingerprint was printed evenly on several media. Complete latent print quality was checked and latent printouts on all surfaces were left at room temperature. Then checked immediately within 1 to 2 h. Each sample was collected in a state containing sebum (oil) especially from the face, hair, behind the ears and forehead.

Development of latent fingerprints: The dusting method of turmeric powder was carried out by latent printing on non-porous surfaces with a little turmeric powder with the brush. The excess powder from the feather back into the container using a circular pattern was rotated, as well as the brush over the mold so that the latent print was visible on the surface of the object. Then, it was recorded with a latent print camera which was clearly visible for further identification. While the ninhydrin SPR method was done by spraying ninhydrin solution on white A4 paper and doorslag paper contained latent fingerprints and remained for 5 min. Then it was heated with an iron until the fingerprint has been seen and recorded with the camera for further identification.

Fingerprint check: The results of development of visible latent fingerprints were examined by manual identification to determine the shape of the fingerprints formed, colour contrast on the surface and the contrast effect on the test time span.

RESULTS AND DISCUSSION

Development of turmeric powder dusting method: The dusting method is a physical method of increasing latent prints and works mechanically on fingerprint powder particles to the sebum component found on the skin ridge. The application of powder to print by brushing is a simple and easy technique but it also has the disadvantage that brushes that came in contact with the surface which have mold crushing properties and hence the characteristics of ridge can be destroyed. Transparent foil and plastic are shown in Fig. 1. The results of developing latent fingerprints using the dusting method of turmeric powder on the surface of compact disc (CD) and plastic cups are shown in Fig. 2.

Fig. 2 shows the latent fingerprint visualization of dusting method of turmeric powder on different surfaces resulting in the visualization of yellow fingerprints. It also shows different fingerprint patterns starting from the pattern: plain whorl (Fig. 1a); radial loop (Fig. 2b); ulnair loop (Fig. 1c); ulnair loop (Fig. 2a) and twinted the loop. This study used 30 fingerprint samples which were divided into three existing tribes, namely 10 samples of Batak tribes, 10 samples of Javanese tribes and 10 samples of Malay tribes.

Latent fingerprinting was successfully developed using the dusting method of turmeric powder. This was based on the results of developing latent fingerprints present on the glass surface of the preparation, aluminum foil, transparent plastic, plastic cups and CD surfaces and give the characteristics of ridge as seen from the figures. The reason for using turmeric

Fig. 1. Latent fingerprint visualization of the dusting method of turmeric powder in: (a) glass preparation; (b) aluminum foil; (c) transparent plastic

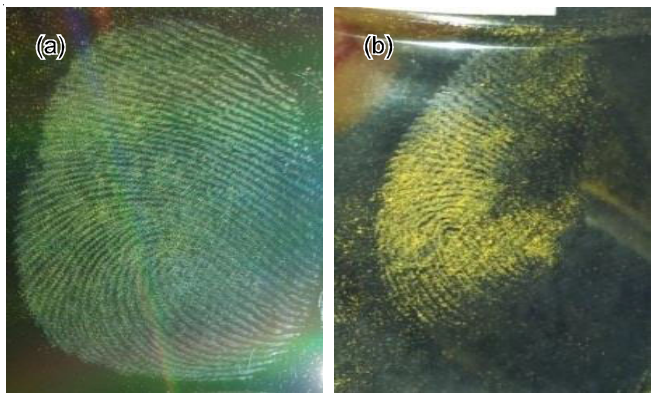

Fig. 2. Latent fingerprint visualization of the turmeric powder dusting method on: (a) CD surface, (b) plastic cups

powder in latent fingerprint visualization might be due to the formation of hydrogen bonds between sebum fatty acid/glyceride with carbonyl and hydroxyl groups from turmeric powder curcuma components. The results of developing latent fingerprints using this method as a whole provide good ridge characteristics on four surfaces, namely glass preparation, aluminum foil, transparent plastic and CD surface. As with plastic cups, this is due to the level of difficulty to print fingerprints on media with smooth surfaces and cylinders. The percentage of fingerprint patterns formed is shown in Fig. 3.

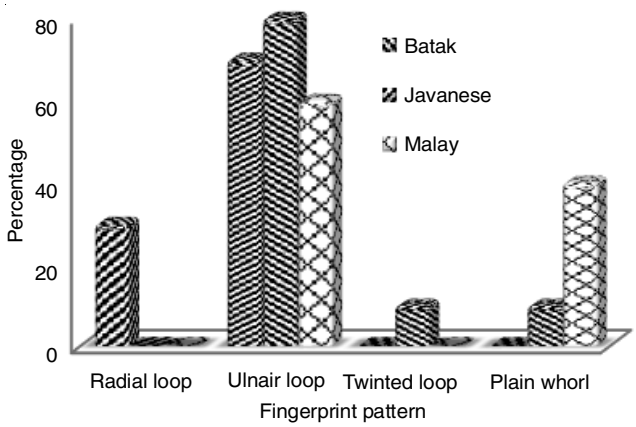

Fig. 3. Percentage of fingerprint patterns using Dusting method

Fig. 3 shows that from 30 samples of the highest percentage in the ulnair loop fingerprint pattern was found to be 70 % in Batak tribe, 80 % in Javanese tribe and 60 % in Malay tribe. This means that ulnair loop fingerprint pattern was very dominant compared to other fingerprint patterns. Another thing shown in this graph was that the Javanese tribe has three variations of patterns, namely ulnair loop, twinted loop and plain whorl. While the Batak and Malay tribes those who only have two variations of patterns were radial and ulnair loops/ulnair and plain whorls. The highest percentage of loop patterns is shown by Javanese as compared to Batak tribe [12]. Whereas in other studies, it is stated that Javanese tribe samples had mostly fingerprint loop patterns [13]. The frequency of arch fingerprint patterns was approximately 5 % of loop fingerprint patterns and whorl [14]. This was consistent with research that data on arch patterns were not found among 30 samples.

Development of small particle reagent (SPR) method using ninhydrin solution: Fingerprints containing sebum were printed on each media that has been provided and then developed with the ninhydrin SPR method. The development of latent fingerprints with the SPR method is done by spraying ninhydrin solution on A4 white paper and doorslag paper that has contained sebum. Then it was dried by heating using an iron until the appearance of the fingerprint painting appears. The results are shown in Fig. 4. Thus, the visualization of Ruheman' Purple fingerprint is clearly observed. The research method was carried out with Criminal Dactyloscopy procedures which suggested that the development of ninhydrin method could be done on the surface of an absorbing (porous) object [15]. This study was also used 30 fingerprint samples which were divided into three existing tribes.

Fig. 5 shows that from 30 samples had the highest percentage in the ulnair loop fingerprint pattern which was of 70 % in Batak tribe, 60 % in Javanese tribe and 40 % in Malay tribe. This means that the ulnair loop fingerprint pattern was dominant compared to other fingerprint patterns. Another thing was noticed that the Javanese and Malay tribes have the same three pattern variations, namely radial loop, ulnair loop and plain whorl (Fig. 5). While Batak tribe has three variations of patterns namely radial loop, ulnair loop and tented Arch.

Based on the literature survey, the highest percentage for the Batak tribe consists of the loop pattern when compared to the Javanese. This was somewhat different from the results of previous studies which obtained the highest percentage of Javanese tribe was a loop pattern compared to the Batak tribe. Whereas other studies stated that the sample of Javanese tribes is often found in loop patterns [12-17]. The frequency of arch fingerprint patterns was approximately 5 % of loop and whorl

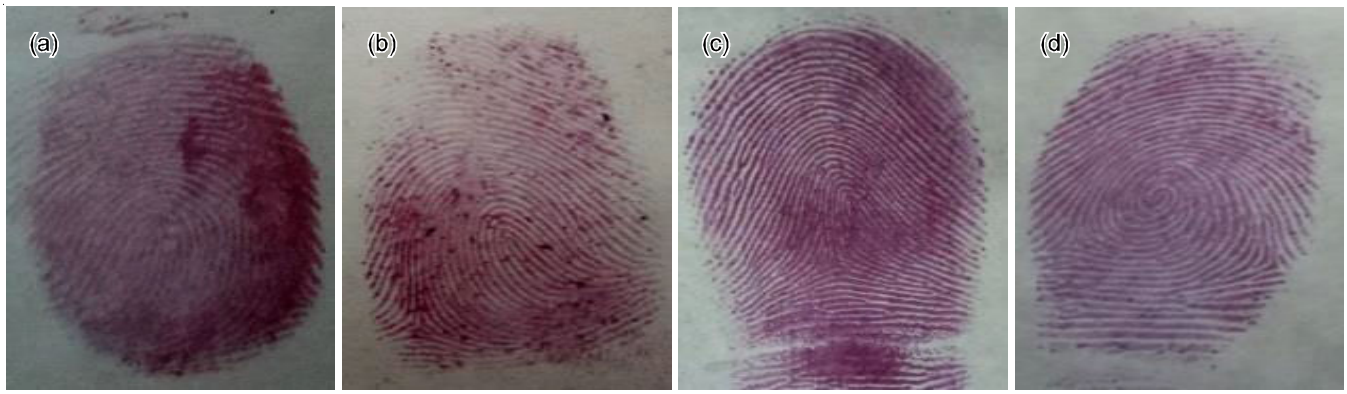

Fig. 4. Visualization of latent fingerprints with the ninhydrin SPR method: (a) radial loop; (b) ulnair loop; (c) tented arch; (d) plain whorl

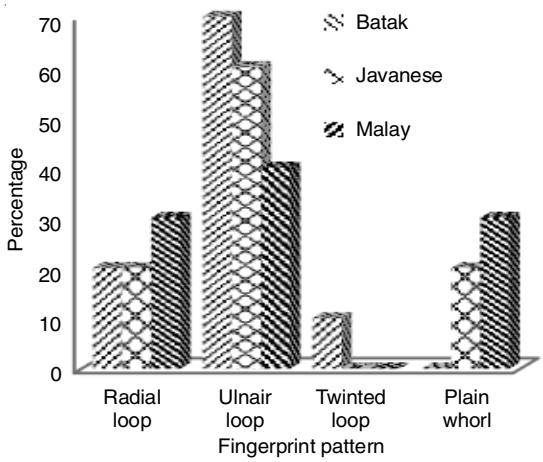

Fig. 5. Percentage of fingerprint patterns using SPR method

fingerprint patterns [14]. This was consistent with studies that data on arch patterns were found to be only 3.3 % among 30 samples. Tented arch was the main shape of fingerprint painting where the lines come from the side of the painting one toward the other side, forming a right angle in the middle. A line or more stands upright in the center.

Comparison of fingerprint visualization using dusting method of turmeric powder and SPR ninhydrin: Comparison of the results of visualization of latent fingerprints with turmeric powder and SPR ninhydrin dusting methods (Figs. 6 and 7). As seen, the development of dusting method provided the low contrast visualization in yellow colour. This colour change indicated that the reaction between turmeric powder and alanine due to the conjugation so that colour intensity on the surface increases. The length of colour contrast to the test time span was influenced by the touch or not of the surface containing fingerprints. If the surface was touched or damaged, then the fingerprint will slowly begin to disappear. Unlike the SPR ninhydrin method which provided high contrast with Ruhemann's purple. This change indicated that the reaction between ninhydrin and alanine in sweat. The length of colour contrast to the test time span was influenced by the place of storage. In high contrast images, the dark parts would be very dark and the bright parts would be very bright. In contrast, low contrast did not have a significant difference between light and darkness significantly.

Effect of turmeric powder size on fingerprint visualization: The results of the study showed variations in fingerprint patterns, namely radial loops, ulnair loops, twinted loops, tented arch and plain whorls. The percentage of each was 16.6, 63.3, 1.6, 1.6 and 16.6 %, respectively. To show the difference between fingerprint shapes based on the size of turmeric powder from

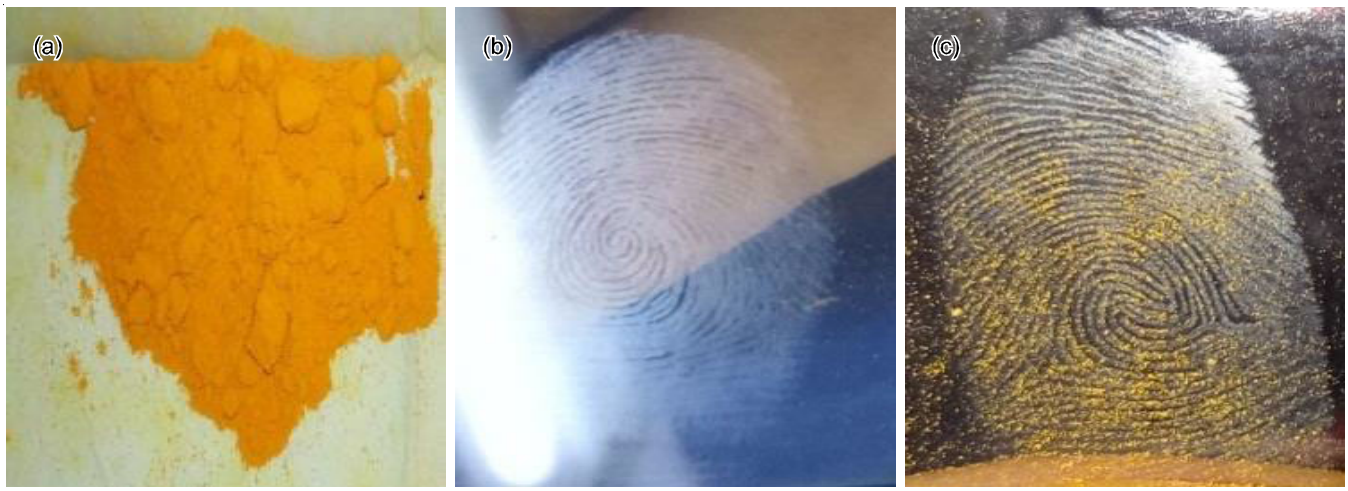

Fig. 6. Curcumin in the following conditions: (a) initial; (b) prior to latent fingerprints; (c) after the latent fingerprint

Fig. 7. Ninhydrin solution in the following conditions: (a) initial; (b) prior to latent fingerprints; (c) after using latent fingerprint

60 to 200 mesh can be seen from the following explanation. The main shape of fingerprint painting lines was came from the side of the painting one toward the other side, forming a right angle in the middle. A line or more standing upright in the center. This shape was a feature of the radial loop pattern (Fig. 8).

The main form of fingerprint painting has two deltas on the right and on the left. This form was characteristic of the pattern of plain whorl (Fig. 9). Whereas the main shape of the painting prints one or more lines was came from one side of the painting, curves/touches and crosses a shadow line drawn between the delta and the core, and stops/tends to stop towards the side. This form was a form of ulnar loop pattern (Fig. 9).

Fig. 10 shows the characteristics of a clear fingerprint ridge with different mesh sizes. The larger the mesh size, the more clearly the characteristics of the fingerprint ridge were produced. The main form of fingerprint painting consisted of two separate loops and each has its own shoulder loop and has two deltas. This form was a feature of the twinned loop pattern (Fig. 10).

Fig. 11 shows that the dusting method of turmeric powder size 60, 80, 100 and 200 mesh would provided a low contrast visualization with yellow colour on different surfaces. However, in this study, there were two results, namely the perfect visualization results on the glass surface of the preparation, aluminum foil and CD surface.

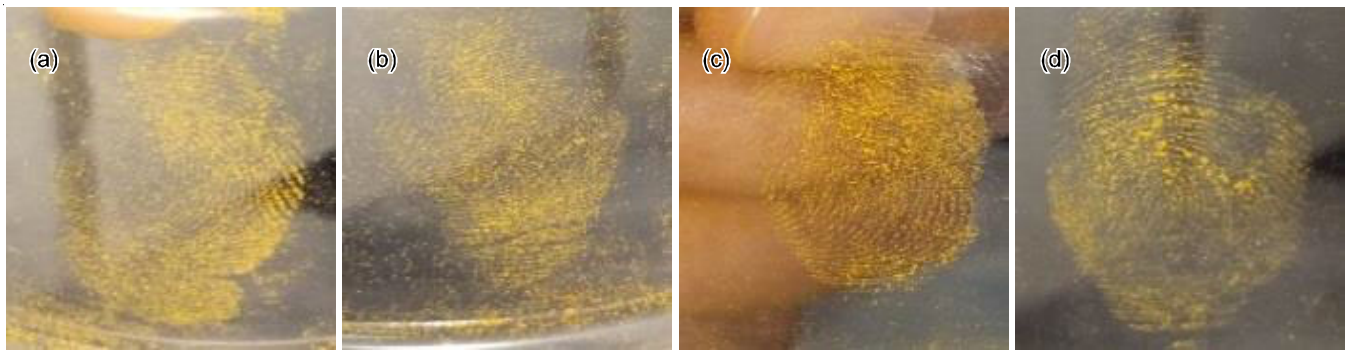

Fig. 8. Comparison of visualization of radial loop pattern fingerprints on plastic cups size: (a) 60 mesh oven; (b) 60 mesh sun; (c) 80 mesh oven; (d) 80 mesh sun

Fig. 9. Comparison of visualization of plain whorl pattern fingerprints on glass preparation sizes: (a) 100 mesh oven; (b) 100 mesh sun; (c) 200 mesh oven; (d) 200 mesh sun

Fig. 10. Comparison of ulnair loop pattern fingerprint visualization on aluminum foil size: (a) 100 mesh oven; (b) 100 mesh sun; (c) 200 mesh oven; (d) 200 mesh sun

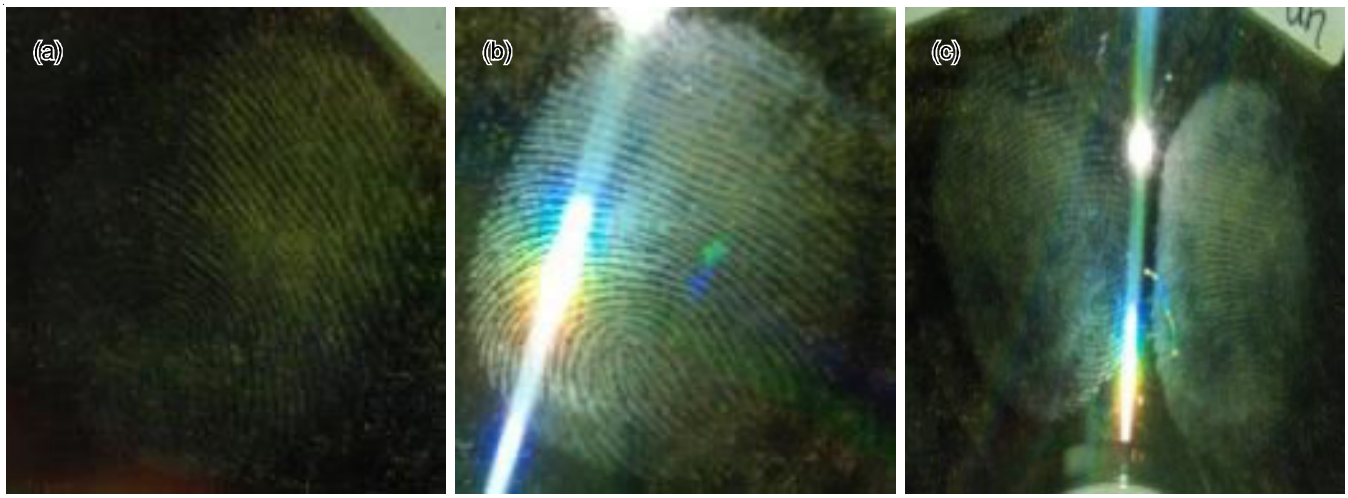

Fig. 11. Comparison of twinted loop pattern fingerprint visualization on CD surface size: (a) 100 mesh oven; (b) 100 mesh sun; (c) 200 mesh oven; (d) 200 mesh sun

While the visualization results were not perfect on transparent plastic media and plastic cups, so it was difficult to identify fingerprint patterns. This was different from previous studies that successfully visualized fingerprints on bond paper, scrap paper, wood surfaces, plastic sheets, transparent sheets, aluminum foil, steel surfaces and CD surfaces for sizes of 100 and 200 mesh will give good results on aluminum foil and CD surfaces. Whereas for sizes 60 and 80 mesh will give good results on glass preparation and transparent plastic. The effect of size of turmeric powder has an effect on the surface area and colour contrast given. Contrast enhancement occurs due to the addition of surface area in the process of sieving turmeric powder. The size of 60 mesh and 80 mesh would gave the characteristics of a bad ridge. While the size of 100 and 200 mesh would gave good ridge characteristics. The higher the sieve size, the lower the colour contrast level [18]. It might be due to the smaller particle size, the surface area of the material will increase [19,20].

Conclusion

In this study, it is concluded that the development of latent fingerprints was successfully performed using the dusting method of turmeric powder and small particle reagent ninhydrin. The results of the comparison of latent fingerprint visualization with the dusting method of turmeric powder and small particle reagent ninhydrin could be seen from the colour contrast formed. The colour contrast of turmeric powder dusting method gave a yellow colour, while SPR ninhydrin method gave Ruhemann's Purple. The effect of size of turmeric powder on the results of latent fingerprint visualization using the dusting method on glass preparation media, aluminum foil, transparent plastic, plastic cups and CD surface would gave a good yellow contrast. The results of this study indicated that the perfect visualization was observed on glass preparation media, aluminum foil and CD surface when used 100 and 200 mesh sieves.

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CONFLICT OF INTEREST

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

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