DETECTION LATENT FINGERPRINTS ON WET NONPOROUS SURFACE

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Fingerprints are one of the important evidences for establishing the identification of a suspect. Latent prints are the fingerprint which can be found at a crime scene or on objects related to criminal matters but they are less visible or invisible. Thus application techniques are necessary for developing latent prints but all techniques are based on the surface texture which bears latent prints. One of the major problems is trying to visualize the latent prints on wet surface. One of the most effective application techniques for developing latent prints on wet nonporous surfaces is Small Particle Reagent (SPR).

This study investigated the appropriate formula of SPR and its efficiency for developing latent prints on wet nonporous surfaces (glass, metal plate and plastic) at various times. Three formulas of SPR were compared: the most appropriate one was SPR III which gave the highest quality of developed latent prints. Fingerprints were impressed on wet nonporous surfaces and latent prints were developed by SPR III at hourly intervals, 1-6 hour after the fingerprints impression. The quality of the latent prints increased with time. In addition when fingerprints were impressed on nonporous surfaces; then they were immersed in tap water for 1 day, 1 week to 5 weeks. Latent prints were developed by SPR III; the quality of the developed latent prints was better when the immersion time was shorter.

Keywords:
LATENT PRINTS / SMALL PARTICLE REAGENT / WET NONPOROUS SURFACE

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Introduction

In crime scene many evidences can be presented in various forms. Most of the evidences are used to provide the investigation. Fingerprint is also one of the important evidence which has high value for the investigation and must be considered when the crime scene is occurred [1].

There are two general types of the fingerprint evidence that can be found at crime scene or on objects which related to criminal matters. They are visible print and latent print; these types are not mutually exclusive. In this study latent print was mainly concerned [2, 3].

Latent print is the fingerprint which presents but less visible or invisible. It can be found on both porous and nonporous surfaces which can be dried or wet.

The latent print caused by perspiration which consists of a complex mixture of natural secretions (organic and inorganic compounds) and contaminants of the environment. Thus, the applications of many techniques for developing latent print are required for detection or enhancement the appearing of the fingerprint.

Small Particle Reagent (SPR) is another name for Molybdenum Disulfide (MoS2). It is a physical development technique where small black particles adhere to the fatty substances left in fingerprint residue. This solution has been used successfully on paper, cardboard, new metal, rusty metal, bricks, rocks, concrete, plastic, vinyl, wood, galvanized metal, and glass [4].

The aims of this study were to find the appropriate concentration of Molybdenum disulfide and Tergitol 7 in SPR preparations in order to develop latent print on wet non-porous surface and to evaluate the developed latent prints on wet nonporous surfaces at various times intervals.

Materials and Methods

1. Materials

Three types of nonporous surface sample (glass, metal plate and plastic) and three formulas of SPR preparations were used in the present study. SPR I [2], II [4] and III [5] were prepared according to the formulas:

SPR I : Consists of Detergent solution (4 ml Tergitol 7 + Water 500 ml), Stock solution (Molybdenum disulfide powder 15 g + Detergent solution 100 ml), and Working solution (Stock solution 100 ml. + Water 900 ml).

SPR II : Consists of Surfactant stock solution (8 ml Tergitol 7 + distilled water 500 ml), Working solution (Molybdenum disulfide 10 g + Surfactant stock solution 50 ml + distilled water 900 ml)

SPR III: Consists of Stock solution (Molybdenum disulfide powder 10 g + 0.8 ml Tergitol 7 + Tap water 100 ml) and Working solution (Stock solution 100 ml + Tap water 600 ml)

2. SPR Formulas

Fingerprint impression was performed on the dry nonporous surface samples (glass, plastic and metal plate). The samples were then immersed into tray of tap water for 1 week. Sample bearing latent fingerprints were detected using SPR I, SPR II, and SPR III. The appropriate formula of SPR (SPR III) which gave the highest quality of developed latent prints was obtained and used in further study.

3. Experimental Methods

This experiment was performed according to the concepts that latent prints detection by SPR on nonporous surface samples which were wet before or after fingerprints deposition at various times

- The nonporous surface samples with latent prints were immersed into tap water for 1 day, and 1 week to 5 weeks. Then the latent prints were detected by SPR III.

- The nonporous surface samples (without latent prints) were wet by briefly dipped into tap water and then the fingerprint impression was performed on the samples. The latent prints were detected after 1 to 6 hrs by SPR III.

4. Fingerprint Lifting

After detection of latent prints with SPR III, the developed latent prints were lifted by using a transparent lifting tape for analysis.

The overview of the experimental methods was shown in Figure 1. Four fingerprint donors and six of each surface samples (glass, plastic, metal plate) were used and two fingerprints were impressed on each surface.

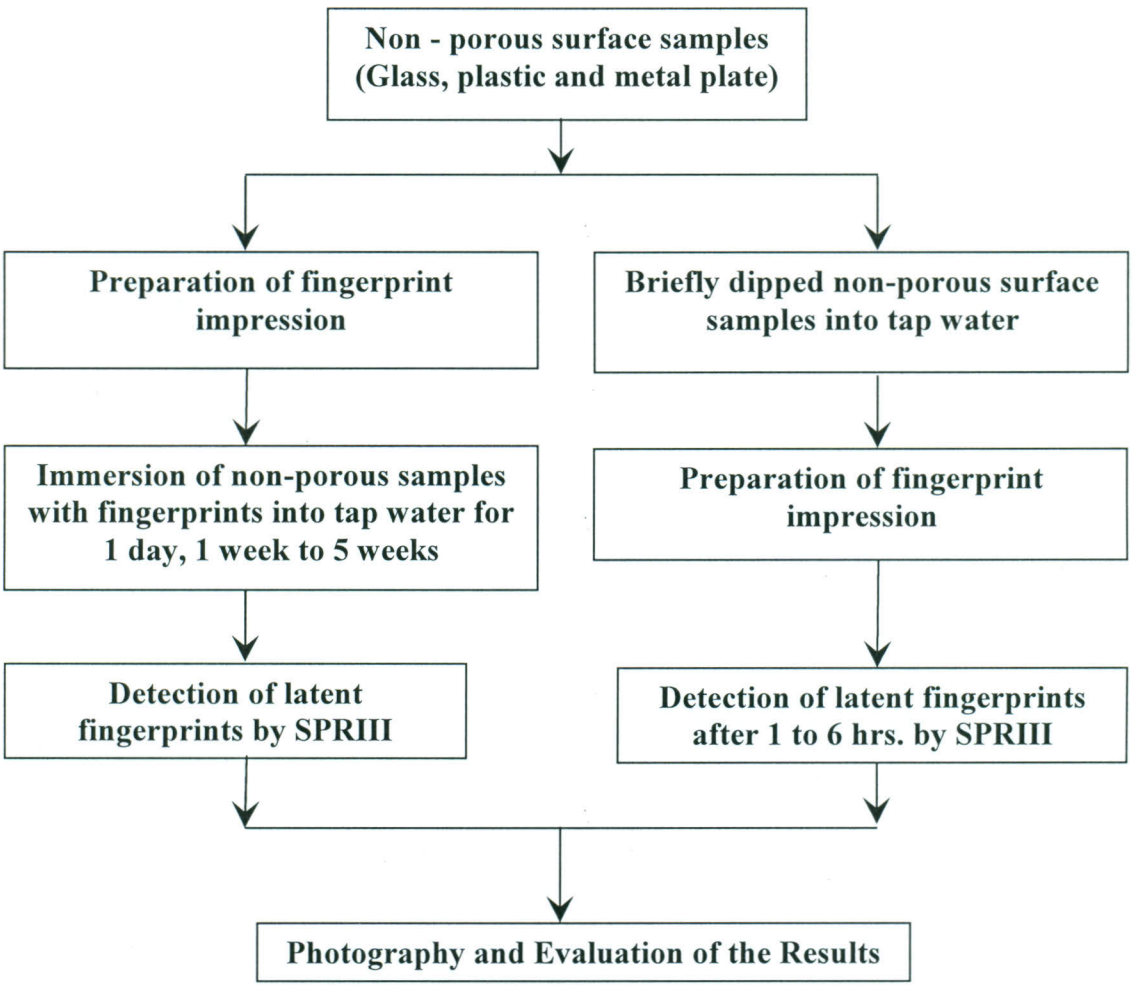

Figure 1. Sequence of methods used for the detection of latent prints on wet nonporous surface by SPR III

5. Criteria for Quality Classification

Five levels of criteria were assigned to the results of developed latent prints. The developed latent prints was evaluated by comparing to the inked prints (reference prints) [6-8] part by part. The developed prints and the inked prints were divided into 8 parts then each counterpart was compared. The latter was 100% complete prints when compare to the former. (Figure 2).

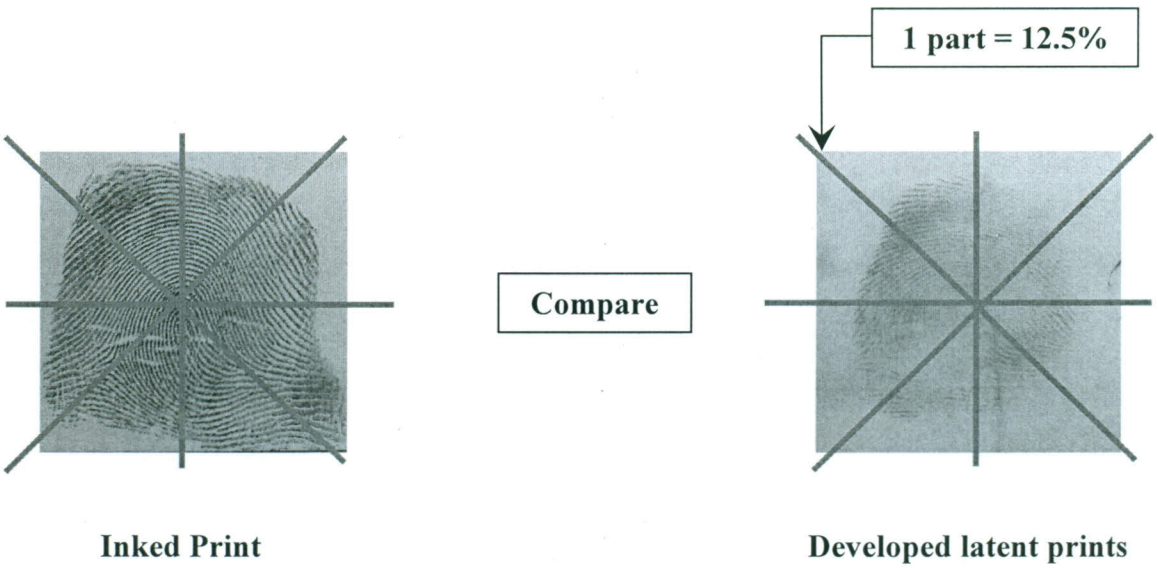

Figure 2. Comparison of the inked print and the developed latent print on each surface part by part

Results

The quality of developed latent prints (%) detected by each SPR formula after 1 week of immersion in tray of tap water were illustrated in Table 1 and the examples of the criteria of developed prints were shown in Figure 3.

Table 1 showing the average values of the quality of developed latent prints on nonporous surface samples and detecting by SPR I, SPR II and SPR III were 36.83%, 27.10% and 51.63%, respectively. According to the criteria, nearly complete developed latent print was obtained from SPR III (51.63%). Partial developed latent prints were obtained from SPR I (36.83%) and SPR II (27.10%).

Table 1. The quality of developed latent prints (%) detected by each SPR formula after 1 week of immersion in tap water.

Donors	Nonporous surface samples	Quality of developed latent print (%) by SPR Formulas			Average (%)
		SPR I	SPR II	SPR III	
1	Glass	60.46	37.5	88.54	**62.17**
	Metal plate	38.54	29.17	77.88	**48.53**
	Plastic	22.90	14.58	27.08	**21.52**
2	Glass	56.25	38.54	70.83	**55.21**
	Metal plate	37.80	40.63	53.13	**43.85**
	Plastic	12.50	0	16.67	**9.72**
3	Glass	65.62	35.40	71.88	**57.63**
	Metal plate	15.63	32.30	29.17	**25.70**
	Plastic	14.58	0	20.83	**11.80**
4	Glass	56.25	52.30	85.42	**64.66**
	Metal plate	46.88	32.29	61.45	**46.87**
	Plastic	14.50	12.50	16.67	**14.56**
Average (%)		**36.83**	**27.10**	**51.63**	

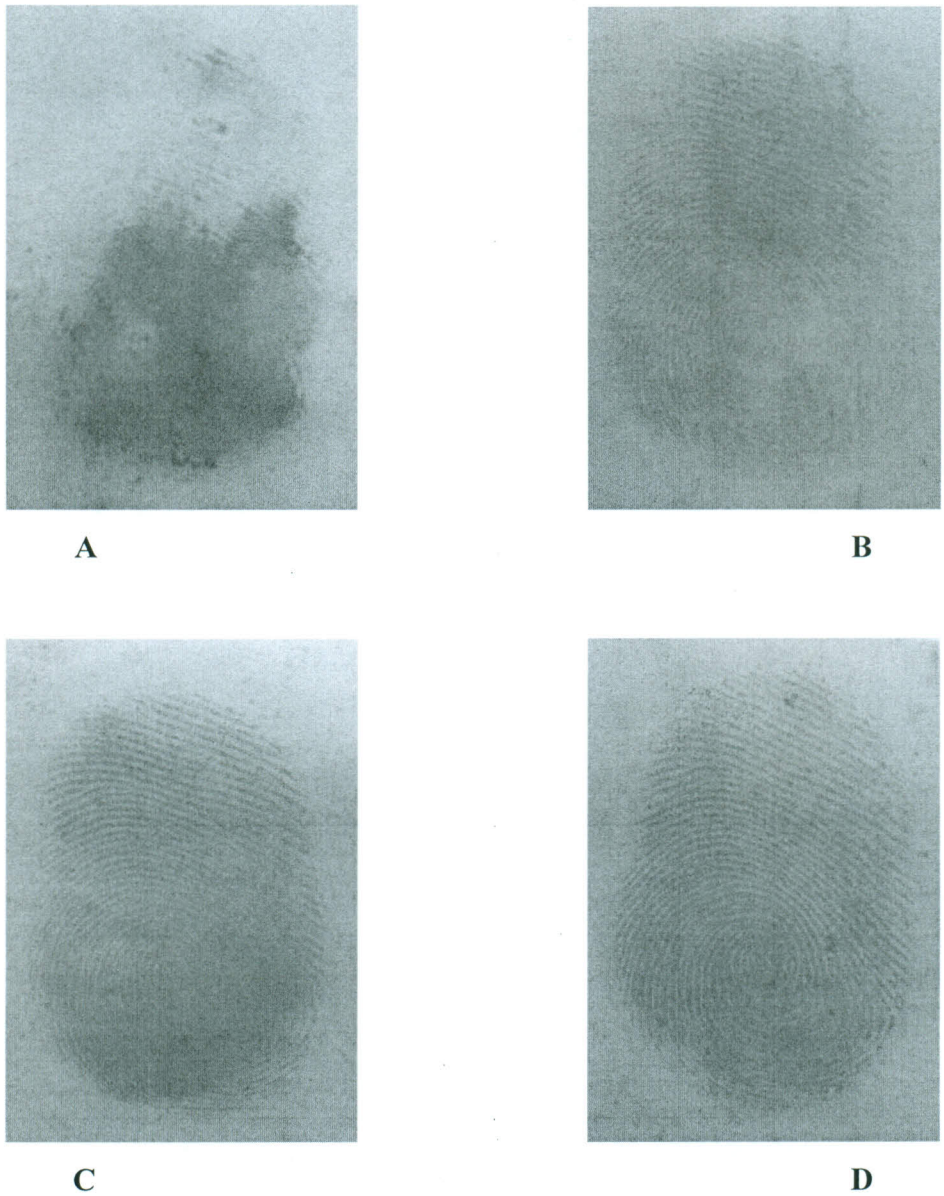

Figure 3. The quality of developed latent prints according to the criteria:

A = Poor developed latent print (10-25%)

B = Partial developed latent print (25-50%)

C = Nearly complete developed latent print (50-75%)

D = Complete developed latent print (75–100%)

E = No developed latent prints (<10%), not shown

Table 2 showing the quality of developed latent prints on every nonporous surface sample was higher at the longer times. At 1 to 6 hrs were 54.67%, 61.28%, 65.17%, 72%, 75.59% and 78.11%, respectively. The average values obtained on glass at 1 to 6 hours after fingerprints impression were 67.94%, 73.69%, 81.19%, 87.24%, 89.52% and 90.88%, respectively. The average values on plastic at 1 to 6 hours were 55.72%, 65.10%, 64.58%, 70.52%, 75% and 77.60%, respectively. The average values on metal plate at 1 to 6 hours were 40.36%, 45.05%, 49.74%, 58.34%, 62.25% and 65.87%, respectively.

Table 2 Developed latent prints from nonporous surface samples which were wet prior fingerprints impression at various times of detection by SPR III

Nonporous surface samples	**Donors**	**Quality of developed latent prints (%) at various times of detection after latent prints impression (hrs)**						**Average (%)**
		1 (hr)	**2 (hrs)**	**3 (hrs)**	**4 (hrs)**	**5 (hrs)**	**6 (hrs)**	
Glass	**1**	88.42	93.75	100	100	100	100	**97.03**
	2	65.62	75	77.88	85.42	85.42	88.54	**79.65**
	3	56.25	60.42	71.88	75	77.88	75	**69.41**
	4	61.48	65.62	75	88.54	94.80	100	**80.91**
Average (%)		**67.94**	**73.69**	**81.19**	**87.24**	**89.52**	**90.88**	**81.74**
Plastic	**1**	68.75	75	77.08	79.17	81.25	85.42	**77.78**
	2	39.58	43.75	56.25	56.25	66.67	70.83	**55.56**
	3	50	75	56.25	71.66	75	75	**67.15**
	4	64.58	66.67	68.75	75	77.08	79.17	**71.88**
Average (%)		**55.72**	**65.10**	**64.58**	**70.52**	**75**	**77.60**	**68.09**
Metal plate	**1**	43.75	43.75	48.96	56.25	71.88	71.88	**56.07**
	2	37.50	38.54	40.63	43.75	43.75	53.13	**42.88**
	3	39.58	41.67	48.96	61.48	61.48	63.54	**52.79**
	4	40.63	56.25	60.42	71.88	71.88	75	**62.68**
Average (%)		**40.36**	**45.05**	**49.74**	**58.34**	**62.25**	**65.87**	**53.06**
Total Average (%)		**54.67**	**61.28**	**65.17**	**72**	**75.59**	**78.11**	

Tables 3 showing the quality of developed latent prints on nonporous surface samples were higher at shorter time of immersion. At 1 day, 1 week to 5 weeks were 55.63%, 44.74%, 35.07%, 25.26%, 19.35% and 12.75, respectively. The average values on glass at 1 day, 1 week to 5 weeks of detection were 84.55%, 73.44%, 67.71%, 58.85%, 45.57% and 27.59%, respectively. The average values on plastic at 1 day, 1 week to 5 weeks were 22.2%, 14.06%, 6.77%, 0, 0 and 0, respectively. The average values on metal plate at 1 day, 1 week to 5 weeks were 60.15%, 46.72%, 30.73%, 16.93% and 12.50%, respectively.

Table 3 Developed latent prints on nonporous surface samples immersed in tap water at various time after fingerprints impression by applying SPR III.

Nonporous surface samples	**Donors**	**Quality of developed latent prints (%) at various time of immersion after fingerprints impression (day/weeks)**						**Average (%)**
		1 (day)	**1 (wk)**	**2 (wks)**	**3 (wks)**	**4 (wks)**	**5 (wks)**	
Glass	**1**	100	97.92	94.80	93.75	88.54	40.60	85.94
	2	88.42	60.42	56.25	32.30	19.80	14.58	45.93
	3	71.88	60.42	48.96	43.75	38.54	28.13	48.61
	4	77.88	75	70.83	65.62	35.40	27.08	58.64
Average (%)		**84.55**	**73.44**	**67.71**	**58.85**	**45.57**	**27.59**	**59.62**
Plastic	**1**	22.17	18.75	14.58	0	0	0	9.25
	2	22.90	14.58	0	0	0	0	6.24
	3	20.83	16.67	12.50	0	0	0	8.33
	4	22.90	6.25	0	0	0	0	4.85
Average (%)		**22.2**	**14.06**	**6.77**	**0**	**0**	**0**	**7.17**
Metal plate	**1**	75	52.5	38.54	19.80	18.75	16.67	36.87
	2	51.04	40.63	22.92	15.63	0	0	21.70
	3	53.13	37.50	29.17	16.67	15.63	10.42	27.09
	4	61.45	56.25	32.29	15.63	15.63	15.63	32.81
Average (%)		**60.15**	**46.72**	**30.73**	**16.93**	**12.50**	**10.68**	**29.62**
Total Average (%)		**55.63**	**44.74**	**35.07**	**25.26**	**19.35**	**12.75**	

Discussions

The present study showed that the best quality of developed latent prints on wet nonporous surface samples was obtained by SPR III [2]. Glass and plastic gave the highest and the lowest quality, respectively.

Developed latent prints on nonporous surface samples which were wet before fingerprints impression, the highest quality was obtained at longer time (6 hrs) after fingerprint impression. The longer the prints left on the wet surface, the more the water to evaporate and the better the prints developed by SPR III. Glass dried quicker and showed the best result, this was due to the surface tension of each nonporous surface sample.

The quality of developed latent prints decreased with the increasing time of immersion. The longer time of immersion to water the more mucous like material are coated on the surface. The best results were obtained on glass. The lowest quality was obtained on plastic, no developed latent prints could be detected at 3 to 5 weeks. However, the quality of the developed latent print was related to the different amount of dermal traces left by each donor, as a consequence of their different emotional state and physiology.

Small Particle Reagent (SPR) or Molybdenum Disulfide (MoS2) is a technique where small black particles adhere to the fatty substances left in fingerprint residue [4].

Conclusions

SPR III was the best SPR formula in the present study which gave the highest quality of developed latent prints on wet nonporous surface samples. The lowest quality was obtained by SPR II. The highest and lowest qualities of prints were obtained on glass and plastic, respectively.

Developed latent prints on nonporous surface samples which were wet before fingerprints impression, the highest quality was obtained at longer time (6 hrs).

Developed latent prints on nonporous surface samples immersed in tap water at various time after fingerprints impression, the highest quality was obtained in shorter time of immersion (1day); and the best results were obtained on glass. The lowest quality was obtained on plastic, no developed latent prints could be seen at 3 to 5 weeks.

Acknowledgement

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