Original Article

International Journal of Forensic Science
Volume 3 Number 2, July–December 2020

Comparative Study for Developing of Latent Fingerprints with Two Different Compositions of SPR on Wet Glass Surface

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How to cite this article:

Meesha Aurora, Hemant Pandey, Pooja Sahani, et al. Comparative Study for Developing of Latent Fingerprints with Two Different Compositions of SPR on Wet Glass Surface. International Journal of Forensic Science. 2020;3(2):97–100.

Abstract

Pertaining to the volatile nature of sweat and presence of latent fingerprints as a chance-evidence on a large number of crime scenes, quick discovery and development of fingerprint is of due importance. As the immediate recovery of the evidence is not possible and due to the dynamic nature of the crime scene, especially in cases of the outdoor crime scene, the recovery of such evidence becomes quite cumbersome. Small Particle Reagent (SPR), by now, is a proven technique for developing fingerprints on wet non-porous surfaces. In the article, the authors compare the two SPR reagents Crystal Violet and Molybdenum di-sulphide for developing fingerprints that have been immersed in water for different time durations. The formulation of Crystal Violet is composed of basic zinc carbonate hydroxide monohydrate (ZnCo3-2Zn(OH)2-H2O)[5] and a commercial liquid detergent i.e. Genteel. Genteel has been used for both Crystal Violet and Molybdenum di-sulphide. The ability to develop chance prints on non-porous wet surfaces by these two reagents is put to comparison. The findings will help choose a better reagent that would develop the latent chance-prints of more clarity.

Keywords: Fingerprint; Sweat; Small particle reagent; Genteel; Crime-scene.

Introduction

Fingermarks are a resultant of sweat deposition from sweat pores present on the palmer side of the hands. Sweat is produced from the eccrine, apocrine and sebaceous glands. Fingerprints are mirror patterns of the friction ridges. Fingerprints are a valuable piece of evidence. We find fingerprints on crime scene in form of latent patent and plastic prints. The most challenging task of identification of fingerprints is posed by latent fingerprints as they are invisible to the naked eye, and hence the work of visualization techniques comes into action.[3] On crime scene, fingerprints can be found on articles that have been accidently or deliberately wetted. Especially in case of under-water crime scene where the body or object remains immersed in water for long durations, in such situations development of prints with conventional dry powder methods prove to be detrimental.[1,4]

SPR or Small Particle Reagent is the technique which comes to rescue. This technique is a means to develop latent fingermarks on wet, non-porous surfaces including glass, plastic, metals and adhesive sides of tape.[2] The fatty component of the sweat traces react with the hydrophobic tail of the specific reagent. The hydrophobic tails are attached to a hydrophilic head, which reacts with metal salt to produce white or black precipitate. SPR is a suspension of Molybdenum di-sulphide, an inorganic compound with the formula MoS2. The compound develops sharp prints that are visible

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to naked eye. Not only is this formulation non-hazardousas compared to the conventional one, but it is cost-effective aswell.[2,6] This follows our interest in the investigation of SPR-based compositions for fingerprint development.

Crystal Violet is a cationic tri-arylmethane dye. It is soluble in water and in a wide variety of organic solvents, excluding aromatic and aliphatic hydrocarbons.

Crystal Violet is also known by other common names such as Basic violet 3, Gentian Violet, Hexa-methyl pararosaniline chloride. Crystal Violet or Gentian Violet {IUPAC name: Tris [4-(dimethylamino) phenyl]methylium chloride}. It reacts with the fatty portions of the sebaceous sweat. Being a protein dye it also acts as an enhancer for bloody fingerprints. Crystal Violet works on non-porous, dry as well as adhesive surfaces.

Materials and Methodology

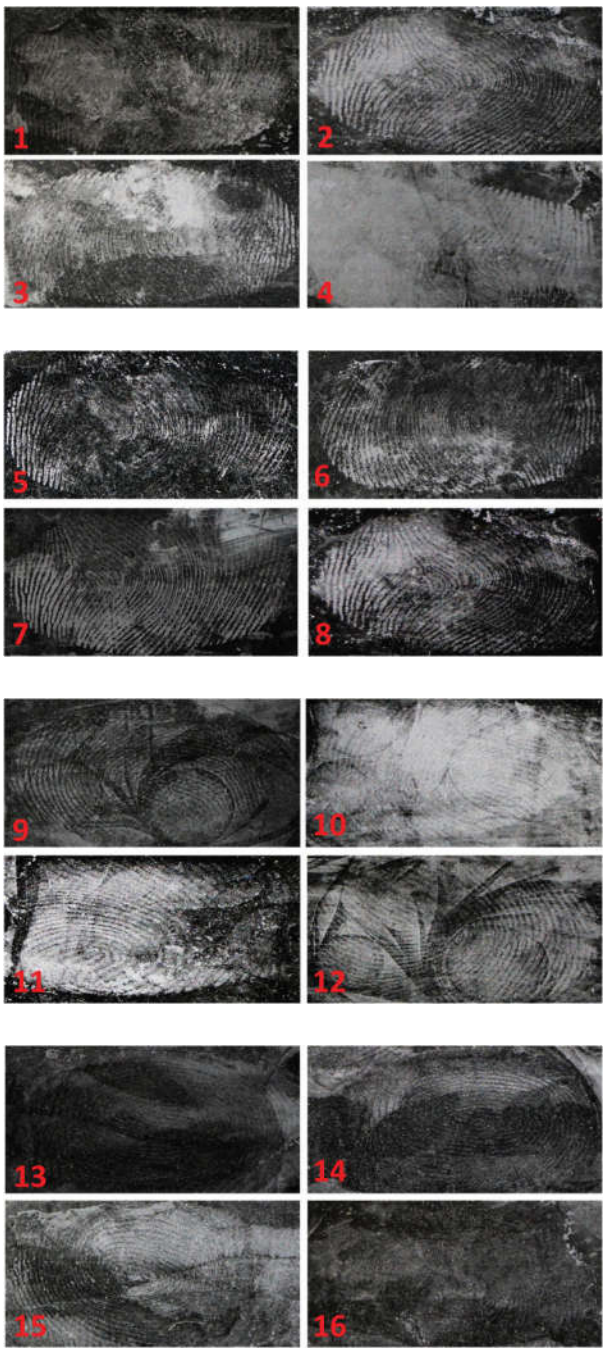
Two reagents were prepared i.e. reagent "A" and reagent "B". Reagent "A" composed of 5g of Basic Zinc Carbonate which acts as a base was taken to which 25 mg of powdered Crystal Violet was added. 3–4 drops of commercial liquid detergent was then added which acts as a binding reagent. To prepare a solution, 75 mL of distilled water was added and the composition was stirred with glass rod for 5–10 minutes.

At the same time reagent "B" was prepared by adding 50 mL of distilled water to 5 g of Molybdenum Di-sulphide. Stirring well with a glass rod, add 3–4 drops of commercial liquid detergent. Again added 25 mL of distilled water and finally stirred for 5–10 minutes.

Clean glass slides were taken and latent fingerprints were taken on them. All slides were immersed in water. After that at particular hours, slides were taken out and were treated with reagent "A" and reagent "B". The slides were kept undisturbed for 5–10 minutes and then washed gently. Same procedure was followed to obtain the reading till 24 hours. Finally, the fingerprints developed on the glass surface were photographed by the DSLR camera.

Results and Discussion

The latent fingerprints taken on the glass surface were immersed in tap water for different time intervals. These fingerprints were developed by using different formulations of SPR i.e. Molybdenum Di-sulphide and Crystal Violet dye. By using Molybdenum Di-sulphide the fingerprints were developed to the extent that ridges were either clearly visible or quite faded. Ultimately the ridge characteristics could be easily interpreted. On the other hand the fingerprints developed by using Crystal Violet were not so good. These prints were not visible with naked eyes, so these were enhanced by polylight. (Fig. 1)



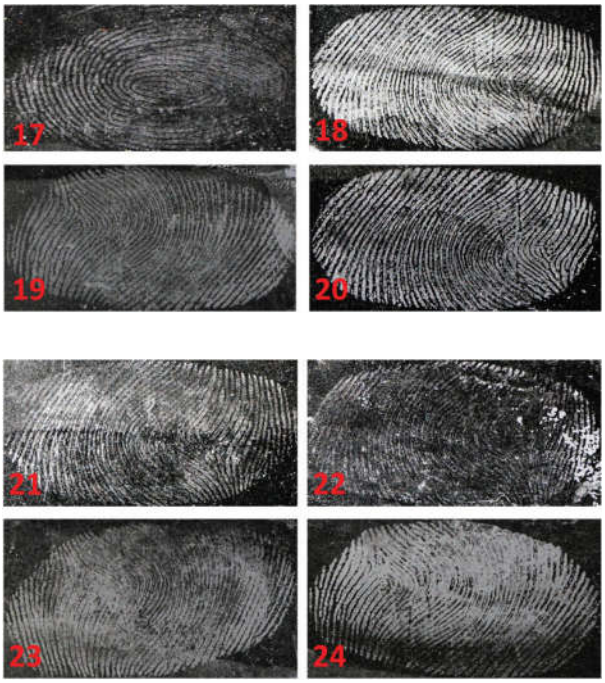
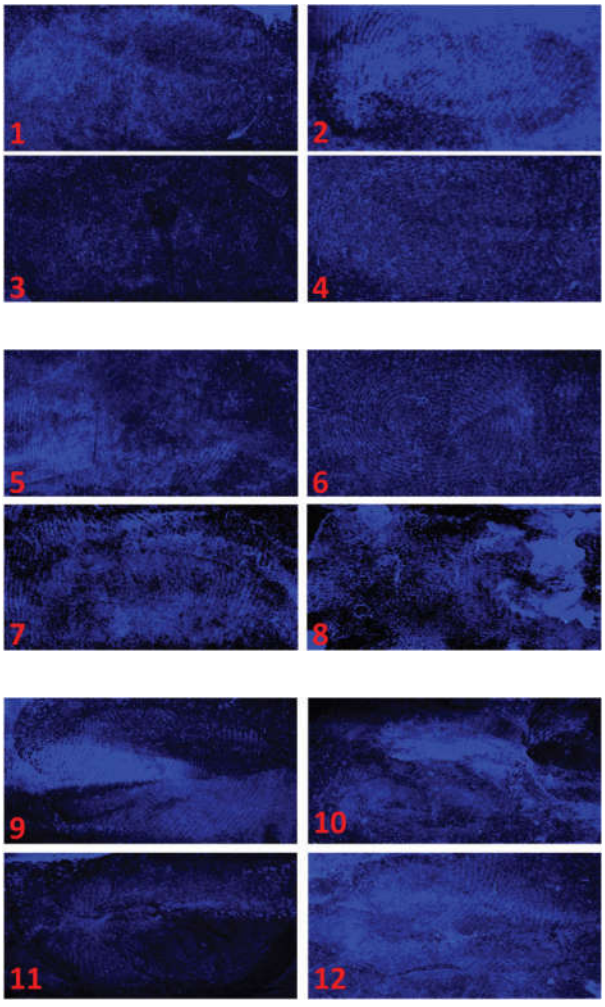


Fig. 1: Fingerprints developed with Molybdenum Di-sulphide.



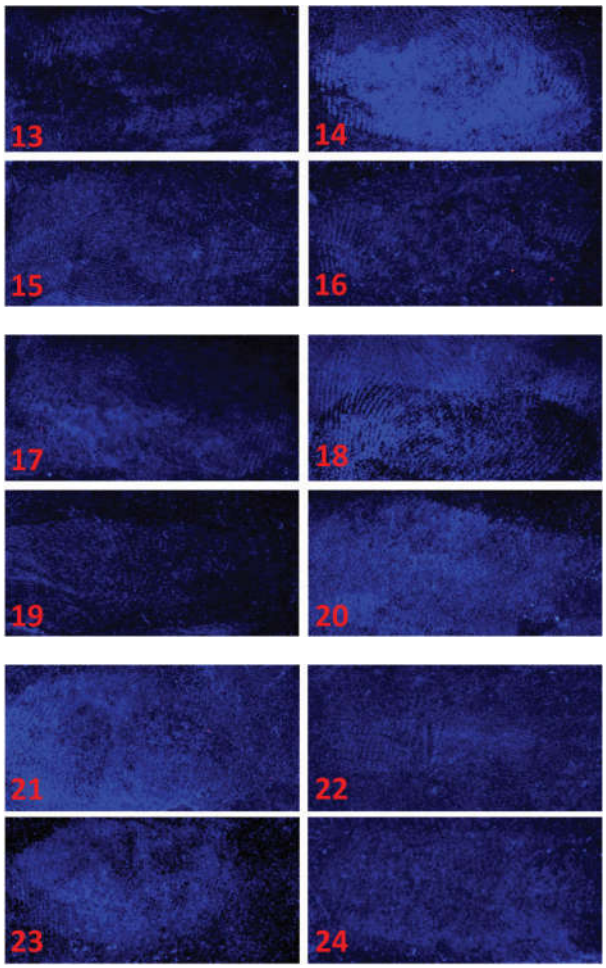


Fig. 2: Fingerprints developed with Crystal Violet.

The comparison study carried out between Molybdenum Di-sulphide and Crystal Violet as reagents for development of latent fingerprints shows that the fingerprints immersed for 13 and 16 hours are quite faded and poorly visible on being developed with Molybdenum Di-sulphide, and hence these are given grade "E". The fingerprints immersed for 1, 2, 3, 4, 10, 11, 12, 14 and 15 hours are very less visible on developing with Molybdenum Di-sulphide, hence it is given grade "D". Immersion for 5, 6, 9 and 22 hours resulted in grade "C" fingerprints. Grade "B" fingerprints are obtained from 7, 8, 17, 21 and 23 hours. Best fingerprints are obtained in case of 18, 19, 20 and 24 hours, which are grade "A" fingerprints.(Table 1)

The fingerprints developed with Crystal Violet after immersing for 3, 10, 13, 29, 20, 21 and 24 hours are of very poor quality, so grade "E" is awarded to them. Immersing the fingerprints for 1, 4, 5, 8, 11, 16, 17, 22 and 23 resulted in grade "D" fingerprints. The equality of developed fingerprints got enhanced for 2, 6, 7, 12, 14 and 15 hours immersion, so grade "C" is awarded to them. (Fig. 2)

Table 1: Fingerprints developed with Molybdenum Di-sulphide.

S.No.	Time (in hours)	Grade (from A to E)
1	1	D
2	2	D
3	3	D
4	4	D
5	5	C
6	6	C
7	7	B
8	8	B
9	9	C
10	10	D
11	11	D
12	12	D
13	13	E
14	14	D
15	15	D
16	16	E
17	17	B
18	18	A
19	19	A
20	20	A
21	21	B
22	22	C
23	23	B
24	24	A

Although all the fingerprints developed by Crystal Violet are not so good but the fingerprints for 9 and 18 hours are better than all and these are grade "B" fingerprints. The grading of developed fingerprints by using Crystal Violet is varying randomly with different time intervals.(Table 2)

Table 2: Fingerprints developed with Crystal Violet.

S.No.	Time (in hours)	Grade (from A to E)
1	1	D
2	2	C
3	3	E
4	4	D
5	5	D
6	6	C
7	7	C
8	8	D
9	9	B
10	10	E
11	11	D
12	12	C
13	13	E
14	14	C
15	15	C
16	16	D
17	17	D
18	18	B
19	19	E
20	20	E
21	21	E
22	22	D
23	23	D
24	24	E

Note: The grading of fingerprints is done on the basis of quality of developed fingerprints. Grading is directly proportional to the clarity of latent fingerprints. Grading declines from "A" to "E" as the fingerprints fades.

Conclusion

From this study, it has been concluded that the latent fingerprints developed by using Molybdenum Di-sulphide were of good quality to the extent that minutiae were clearly visible as compared to the fingerprints developed by Crystal Violet dye. It is evident from the results that a fingerprint even after 24 hours of water immersion could be developed effectively and coherently as compared to the fingerprint which was immersed in water for 14–16 hours. The fingerprints were collected from 3 individuals. The fingerprint for the 24th hour and for 14–16th hours were from two different individuals therefore the fingerprints were of varying quality. The quality here means the quality sweat and sebum, and smudging of the fingerprint. Moreover, time since the development of the fingerprint and the methodology to be used for the fingerprint development are also some crucial factors. Hence, it can be interpreted that the random variation in grading of developed fingerprints interpret that clarity of developed fingerprints is directly proportional to the quality of latent fingerprints over the glass surface.

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