International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 20s, 2025
https://theaspd.com/index.php

Novel Powder Compositions For Detecting Latent Fingerprints On A Legion Of Crime Scene

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Abstract
The efficiency and the deposition of the Latent fingerprint are strongly affected by the surface on which prints are deposited. The roughness of the surface the properties of the material the hydrophobicity and chemistry can also effect the efficacy or the usefulness of the forensic print development techniques. For detecting the latent fingerprints the powder technique involves the application of a lightly divided formulation to the finger mark impression, commonly with a glass-fibre or a camel hair brush. Mechanically the powder gets adhered to the sweat deposit defining the ridge pattern. The furrows which are devoid of the fingerprint residue do not hold the powder onto them. The final outcome is that the powder formulation sticks to the ridges, but is easily blown off the furrows. Since the powder is normally coloured, the ridge pattern becomes visible and the latent print is said to have developed.
Keywords: *latent fingerprints, impression, techniques, glass-fibre, powders.*

INTRODUCTION

Fingerprint examination is considered one of the most vital procedures in fingerprint examination. They play a crucial role as dependable means of uniquely, the most valuable evidence that may be found as objects is believed to be fingerprints. Criminalistic offenders are usually careful not to leave behind any evidence at detailed crime and object handling sites. However, latent fingerprints are present in most of the crime scenes. The substrate on which a fingerprint is deposited is typically the first clue as to which process is chosen for contrast enhancement. Porous and nonporous surfaces cover a wide range, and enhancement techniques should be chosen according to the type and porosity of surface, the nature of latent mark and level of contamination introduced to the mark to be enhanced [1]. New methodologies have been introduced for the detection of latent fingerprints but conventional method for detection of latent prints is fingerprint powdering technique and it involves a colorant for contrast and resinous material for good adhesion. When powder is sprinkled over a latent print, it sticks to the oil, perspiration or other material in the print and the pigment in the powder provides contrast between the background surface and the print, allowing the print to be seen. Several techniques have been employed for latent fingerprint detection on different surfaces with the use of powder form of turmeric [2]. synthetic food and festival colours [3] and silica gel G [4]. The findings of their study was suggestive that turmeric powder and Silica gel G are healthful alternatives to other traditional powders such as black magnetic powder, grey powder etc. Results were optimum by Turmeric and synthetic food and festival colours for contrast surfaces. The visualization of latent fingerprint deposited on various surfaces such as, ordinary paper, bond paper, thermal paper, aluminum foil, transparency sheet, wood (sun mica- glossy), plastic sheet, painted steel, top and writing surface of the CD [2],[3],[4] clear ridge details were observed Singh et al [5] Fingerprint could be developed and recovered on food surfaces such as banana, apple and potato when black powder was used alternatively the iodine fuming also developed fingerprints on apple. Another study conducted by Trapecar and Vinkovic [6] concentrated on comparable fruits and vegetables with varying degrees of effectiveness. Their study also looked into the cyano-acrylate fuming process, but the findings were less encouraging. A related study on the enhancement and recovery of latent fingerprints on various fruits, vegetables, and dairy products (egg) was carried out by Fergusan et al. [7]. The most effective magnetic powder on all surfaces was black. Additionally, they saw that SPR produced more than twice as many fingerprints, but with a lower grade. Rohatgi R. et al. [8] carried out an experiment using SPR based on crystal violet dye to produce latent fingerprints on wet non-porous surfaces. When submerged in clean water, the findings were identical for ceramic tile, glass, and aluminum surfaces.

Fingerprint powders contain a number of hazardous and potentially harmful chemical substrates. We have tried to employ novel latent fingerprint development powders that are easy to use, non-toxic, and less costly than the currently available fingerprint powders in order to get around this drawback. Every home has easy access to them. Using common household kitchen food items like cocoa powder, custard powder, corn flour, baking soda, baking powder, black salt, edible food (orange), and turmeric powder, a preliminary attempt has been made in this study to create latent fingerprints. Since this kind of work has never been documented before, it can give investigators valuable information in situations where standard conventional fingerprint development powders are scarce or unavailable.

MATERIALS AND METHODS

64 latent fingerprints were collected on various porous and non-porous surfaces each. Porous surfaces used for the study were normal paper, cardboard and glossy paper while non-porous surfaces were metal, glass, ceramic and plastic while non porous surfaces were currency note and polythene. The individuals' test sebum latent prints were taken from various surfaces. In order to gather sebum prints, participants were instructed to touch their face or forehead, which resulted in sebum on their fingertips. These prints were then placed to several substrates. Since sebum prints are a complicated blend of environmental pollutants and natural secretions, special attention was not paid to contamination on the fingers. As a preliminary investigation, the prints were developed utilizing a powder dusting technique without the use of a brush. Although brushing powder onto prints is a straightforward and quick approach, it has a drawback in that the brush ruins the print as it comes into touch with the print surface, which also eliminates the ridge features. In order to develop latent fingerprints with compositions, [1] 3 grams cornflour powder, 2.5 grams arrowroot, 0.5 grams lycopodium, 25 mg Rose bengal dye with 40 ml water –(R-1) [2] 3 grams starch powder, 3 grams talc, 25 mg Rose bengal dye with 40 ml water -(R2) [3] 3 grams cornflour powder, 2.5 grams arrowroot, 0.5 grams lycopodium, 25 mg Trypan blue dye with 40 ml water-(T1) [4] 3 grams starch powder, 3 grams talc, 25 mg Trypan blue dye with 40 ml water - (T2) [5] 3 grams cornflour powder, 2.5 grams arrowroot, 0.5 grams lycopodium, 25 mg crystal violet dye with 40 ml water –(C1) [6] 3 grams cornflour powder, 2.5 grams arrowroot, 0.5 grams lycopodium, 25 mg crystal violet dye with 40 ml water-(C2) [7] 3 grams starch powder, 3 grams talc, 25 mg Basic Yellow dye with 40 ml water-(Y1) [8] 3 grams cornflour powder, 2.5 grams arrowroot, 0.5 grams lycopodium, 25 mg Basic Yellow dye with 40 ml water (Y2) procured in dry powder form. The powders were weighed and mixed with water and dried in natural sunlight for 7 to 10 days, using motor and pestle all the compositions are grinded. Finely grinded powder placed in glass bottles and sprinkled over the affected surface. To obtain clean prints, the surplus powder was tapped out.Only the best-developed prints from this set were saved for the calculation of the outcome.

The experiment was conducted in February- March of 2024, with temperatures ranging from 19 to 36 degrees Celsius and relative humidity levels between 37% and 54% at Shaheed Rajguru college of Applied Sciences for women University of Delhi .Fingermark quality scale is been used to give fair scores to the fingerprints developed on the surfaces indicated in Table:1.As indicated in Tables 2, 3 and 4 and Graphs 1 and 2, the various powders were applied to each of the aforementioned porous and nonporous surfaces, respectively, to verify the comparative evaluation of surfaces.

RESULTS AND DISCUSSION

The results obtained from present investigation using different powder compositions were given numbering 1 to 5 on a scale as shown in table-1, on various porous and non-porous surfaces are shown in Figures -1. (duration 24 hours). The latent fingerprints present on the surfaces examined can be successfully developed with all powder compositions. It has been observed that latent fingerprints were not developed on currency note, cardboard, ceramic and glossy paper using any powder. In case of plastic the prints were developed but lacked contrast in cases of R-2, CV-1 and CV-2. Least clear and visible prints were developed on porous surfaces. While non-porous surfaces such as metal and glass showed very clear decipherable prints with all powders as shown in table 2 and graph 1 Among the powder compositions used for this experiment, BY-1,BY-2, R-1, R-2 CV-2 and T-2 demonstrated best results on non-porous surfaces.

Table:1 Finger mark quality scale used

Grade	Description
0	No visible prints
1	Poor quality, very few ridges visible
2	Poor quality, some ridge detail visible or partial mark with limited characteristics
3	Reasonable quality, ridge details and some characteristics visible, identification possible.
4	Good quality prints, ridge details and characteristics visible, probable identification
5	Excellent quality, very clear prints, identification assured.

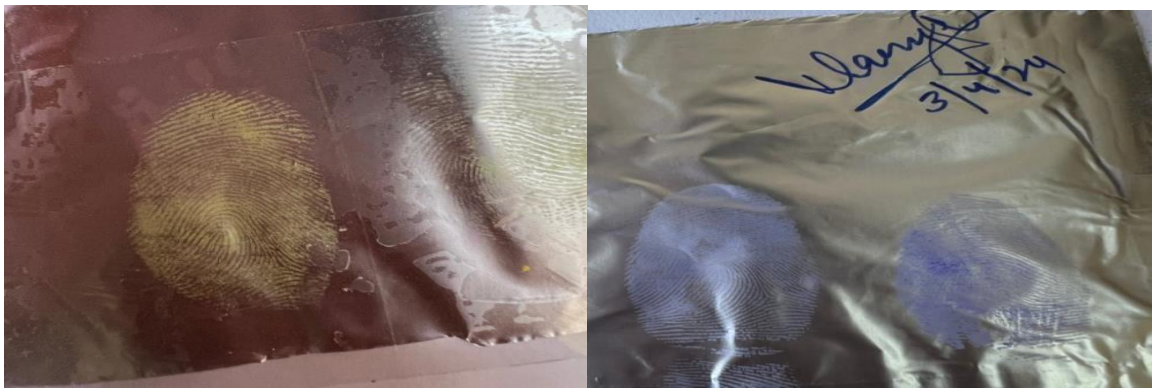
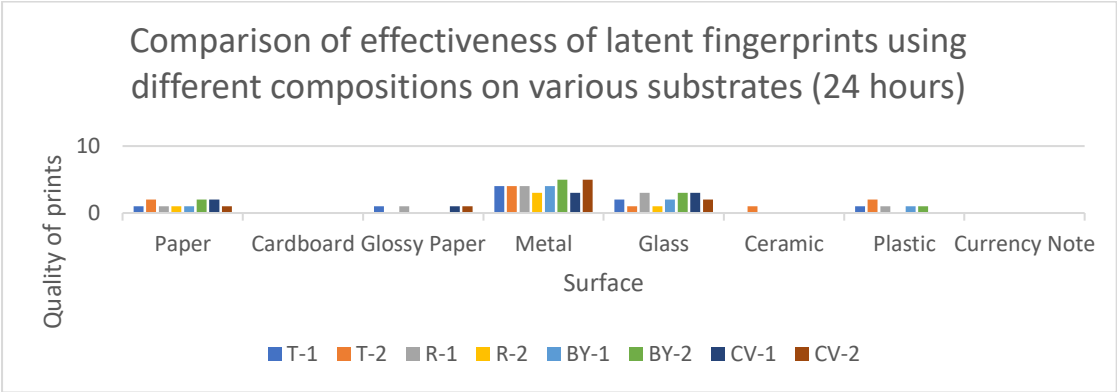


Fig.1 fingerprint developedafter 24 hours (i) basic yellow on metal surface (ii) trypan blue on metal surface.

Table 2: Observations of latent fingerprints developed after 24 hours using fluorescent powder compositions as adhesive on various substrates.

Formulations Surfaces	Paper	Cardboard	Glossy Paper	Metal	Glass	Ceramic	Plastic	Currency Note
T-1	1	0	1	4	2	0	1	0
T-2	2	0	0	4	1	1	2	0
R-1	1	0	1	4	3	0	1	0
R-2	1	0	0	3	1	0	0	0
BY-1	1	0	0	4	2	0	1	0
BY-2	2	0	0	5	3	0	1	0
CV-1	2	0	1	3	3	0	0	0
CV-2	1	0	1	5	2	0	0	0



Graph.1 Comparative depiction of the quality of latent fingerprint developed after 24 hours using dry powder compositions on various surface

The results obtained after 48 hours of duration using different powder compositions form on various porous and non-porous surfaces shown in fig.2.The latent fingerprints present on the surfaces examined

can be successfully developed with all powder compositions. It has been observed that latent fingerprints were not developed on currency note, cardboard, and plastic using any powder. In case of ceramic the prints were developed but lacked contrast. Least clear and visible prints were developed on porous surfaces. While non-porous surfaces such as metal and glass showed very clear decipherable prints with all powders.Among the powder compositions used for this experiment, BY-1,BY-2, R-1, R-2, CV-1, CV-2 and T-2 demonstrated best results on non-porous surfaces as shown in table 3 and graph 2.

Fingerprints developed after 48 hours (i) Tryphan blue on glass surface (ii) Tryphan blue on metal surface.

Table 3: Observations of latent fingerprints developed after 48 hours using fluorescent powder compositions as adhesive on various substrates.

Formulations Surfaces	Paper	Cardboard	Glossy Paper	Metal	Glass	Ceramic	Plastic	Currency Note
T-1	1	0	1	3	2	2	0	0
T-2	1	0	1	3	3	1	0	0
R-1	1	0	2	3	3	2	0	0
R-2	2	0	2	5	2	2	1	0
BY-1	1	0	2	5	3	1	1	0
BY-2	2	0	1	2	2	1	0	0
CV-1	2	0	0	3	1	1	0	0
CV-2	1	0	1	5	2	1	0	0

Table 2: Observations of latent fingerprints developed after 48 hours using fluorescent powder compositions as adhesive on various substrates.

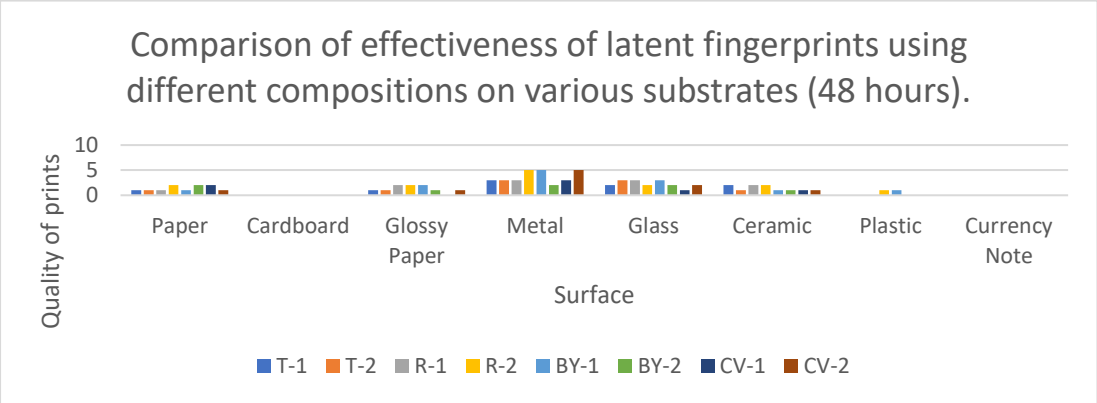


Fig.2 Comparative depiction of the quality of fresh latent fingerprint developed (48 hours) using powder compositions on various surface

The results obtained after 1 week (168 hours) of duration using different powder compositions form on various porous and non-porous surfaces. The latent fingerprints present on the surfaces examined can be successfully developed with all powder compositions. It has been observed that latent fingerprints were

not developed on currency note, cardboard, paper and plastic using any powder. In case of ceramic and plastic the prints were developed but lacked contrast. Least clear and visible prints were developed on porous surfaces. While non-porous surfaces such as metal and glass showed very clear decipherable prints with all powderS. Among the powder compositions used for this experiment, BY-1,BY-2, R-1, R-2, CV-1, CV-2 and T-2 demonstrated best results on non-porous surfaces. Shown in table 4 and graph 3.

Table 4: Observations of latent fingerprints developed after 168 hours using fluorescent powder compositions as adhesive on various substrates.

Formulations Surfaces	Paper	Cardboard	Glossy Paper	Metal	Glass	Ceramic	Plastic	Currency Note
T-1	0	0	0	2	2	0	0	0
T-2	0	0	1	1	3	1	0	0
R-1	0	0	0	2	1	0	0	0
R-2	0	0	1	3	3	1	0	0
BY-1	0	0	1	3	1	2	0	0
BY-2	0	0	1	2	2	2	0	0
CV-1	0	0	0	3	2	2	0	0
CV-2	0	0	1	2	5	1	0	0

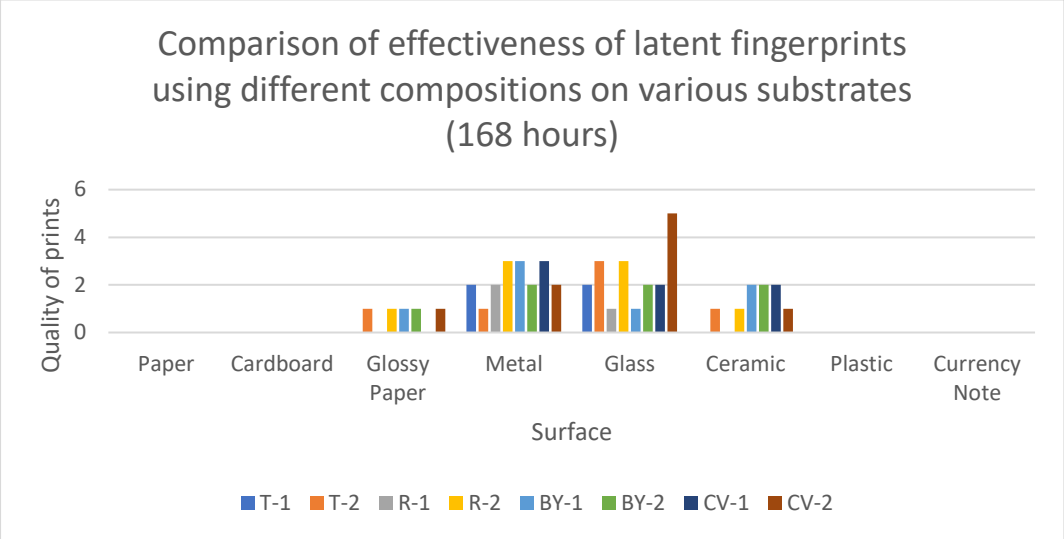


Fig.3 Comparative depiction of the quality of fresh latent fingerprint developed (168 hours) using powder compositions on various surface

The latent fingerprints present on surfaces such as metal and glass were developed and showed clear ridges as is evident from the figures with all powder compositions in different time frame used in the present experiment. The negative results were obtained on plastic, paper and glossy paper. No prints could be developed on currency note and card board due to lack of adherence of sebum from latent fingerprints and developing agents on these surfaces. The present study is a work in this field which is based on physical method of enhancement of latent prints and works on the mechanical adherence of the fingerprint powder particles to the oily components of the skin ridge deposits.

In the present study the compositions have been prepared by adding different dyes. It works on the principle of adhesive and colorant; Adhesive is a combination of organic and inorganic compounds. Adhesive will absorb on the sweat and dye will adsorb on adhesive. Sweat constituent can be tagged easily even after a time gap due to which the latent fingerprints were even developed after 168 hours also. The present study also substantiated that decipherment of fingerprints depends upon the person to person because every individual sebum secretion is different also type of powder used and the type of surface on which the finger prints are present.

CONCLUSION

It can be concluded from the present study that these compositions are less expensive and non-toxic agents could be a useful substitute for the decipherment of latent fingerprints deposited on different surfaces.

These can provide a good substitute for fingerprint visualization for fresh as well as aged fingerprints in comparison particularly to commercially available chemical powders, under the instances of scarcity. Further work on the decipherment of aged latent fingerprints needs to be taken up.

Acknowledgements

I am grateful to my guide DR. Bhoopesh Sharma and co-guides. Dr. jasjeet Kaur and Dr. G.S Sodhi. highly thankful to all the subjects who contributed their fingerprint samples for the experiment purposes.

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