

“Unconventional Powder” A Prodigy in Latent Fingermark Development: A comprehensive Review

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Background

In the present scenario with humongous crime rate and in the fourth age of world, physical evidences are the only guileless witnesses. Since forensic science is the path for justice, physical evidence needs to be understood, evaluate & compare to reach veracity. Given that both scientists and courts recognise the uniqueness of fingerprints, they rank among the most significant types of physical evidence.

Fingermark are the most unerring and surefire evidence with 100% reliability. Also the most frequent one on miscellaneous scene of crime. Fingerprint evidence is valuable because they are unique & permanent and hence can co-relate the crime scene, victim & suspect through evidence linkage triangle.

Among the following 3 types of fingerprint- latent, patent & plastic, latent fingerprint is the most frequently found evidence. In order to perform ACE-V technology, the latent print must be first developed.

Development- powdering method

Since early days of latent fingerprint development, the diligence of finely separated material & subsequent clear the extra powder by tapping, blowing and brushing has been regular method of development of latent prints on non-porous surface. The quality of developed fingerprint depends upon the shape, size and density of particle. A large number of fingerprint powder formulas have been developed over the years. However they have great sensitivity, some pitfalls follows it as well. High selling price, pernicious in nature, unavailability at ordinary places are some drawbacks which turns the head of most experts and scientist towards unconventional powder. Some of the familiar accessible powders triumph over the flaws mentioned above with similar sensitivity in development of latent fingermark as well.

The latent fingerprint development technique using powder method relies on mechanical adherence of powder to the liquid and moisture component of the skin ridges.

The literature survey reveals that there has been continually an endeavor on the part of the expert to look for the new technique that could show clearer ridge details effortlessly and to be keenly priced. This literature is an overview of those articles which throws a light on latent print development through unconventional powder.

Table.1.1 Non-conventional Powder Mentioned In Some Reputed Journal.

S.No.	Year	Journal	Powder
1.	2018	Researchgate	Soil
2.	2018	Springer (EJFS)	Turmeric, cumin, garam masala, limestone, gram flour, coriander
3.	2017	Indo American Journal Of Pharmaceutical Sciences	Durian seeds powder
4.	2016	Springer (EJFS)	Fuller's earth
5.	2015	Journal of chemical, physical and biological science	Baking powder, gram powder, corn flour, chocolate, dry ginger, refined wheat, ranipal, custard, dry mango, neel powder
6.	2015	Scholars research library	Turmeric, chili, pepper, coal powder
7.	2015	Springer (EJFS)	Robin blue powder
8.	2014	Problems of forensic science	White cement
9.	2014	Asian Journal of Science and Applied Technology	cocoa powder, custard powder, corn flour, baking soda, baking powder, black salt, edible food and turmeric powder.
10.	2012	Springer (EJFS)	Silica gel G
11.	2011	Springer (EJFS)	Synthetic food & festival color (gulal)
12.	2011	Springer (EJFS)	Turmeric powder

Methodology

All the above mentioned researches are performed in laboratory condition by following traditional technique. Samples of latent fingerprint are taken on a substrate of a healthy individual by first washing his/her hands thoroughly wipe it to dry to eliminate the possibilities of any contamination. Then after 5 mins they are asked to either closing their fist for 5 minutes or take sebum from face, forehead or chin and press the finger against substrate to deposit prints. In some of the researches for ageing study, the samples were placed as it is for different number of days. The powder for development is prepared by placing it in oven for some minutes to eliminate any moisture present and then packed in a container and sealed so that it can be used afterwards.

1 - Turmeric

The turmeric powder adheres to the latent fingerprints resulting from the hydrogen bonds forming between the hydroxyl & carbonyl group of the curcumin & the fatty acids/glycerides of sebum. **Dhunna et al. 2018** and **R. Adhithya 2015** recognize turmeric as a powder which results in partial identification. **Rohatgi & Kapoor (2014)** performed this experiment by comparing various powders which demonstrate turmeric powder best for non-porous and porous surfaces. It can be seen that in all the above mentioned practices level 1 detail i.e. pattern identification can

easily be done through turmeric powder over majority of the surfaces due to natural color contrast. Although **Rakesh et al. 2011** presented a paper focusing only on turmeric powder. Before applying powder, he grinds it in a blender to get very fine powder to the level of talcum powder. Hence, in this experiment level 2 details i.e. the ridge minutiae is also deciphered. Also in some of the substrate having better contrast color with the powder, level 3 details can also be seen if examined carefully. It can be concluded that commonly available turmeric powder can be used for the development but for the best result the powder should be fined as much as possible.

2 - Fuller's Earth

Dhunna et al. 2018 mentioned fuller's earth as household powder which gives appreciable results on an aluminum foil. The pattern can be distinguished as well as the particulars display can be seen effortlessly. **Thakur & Garg, 2016** claimed fuller's earth as a befitting material for latent fingerprint development. They performed the latent fingerprint development technique over a variety of substrate including porous, non-porous & semi porous surfaces. As expected, fuller's earth performed well over majority of the surfaces. Level 1 detail can be seen in every surface. Best comes about over glass surface, clear edges on non-porous surfaces and foggy picture over permeable and semi-porous surfaces is created. Overall the results obtained are of good quality and the ridge details are also clear to read. Thakur & Garg, 2016 also develop latent prints up to the time period of 6 days in varying temperature. Positive visualization of latent fingerprints kept in sunlight was possible although the development was very light on the last day whereas prints kept in shade were visualized well up to the last day.

3 - Robin Powder Blue (commonly known as Neel powder)

Jossan et al. 2015 performed on a variety of non-conventional powder, Neel powder is one of them. According to him, Neel powder does not give very clear fingerprint on many surfaces. Unlike mentioned above **Badiye & Kapoor, 2015** introduced Neel powder as a very efficacious powder for developing latent print. The powder was tested on 24 different substrates which encountered most on a scene of crime. It was noted that the powder if kept in the open may form clumps probably due to the absorption of moisture from the surrounding atmosphere so for better results it must be dried in an oven before using for development. Good contrast was seen owing to the bright blue color of the developed prints on light-colored surfaces and appreciable result on multicolored surfaces. Both dark and black surfaces feature ridge details that are clearly visible. The prints made for easy photography subjects because of their excellent contrast. Only difficulty found are on some tricky surfaces such as door knob, key chain, coin, gloves etc.

4 - Soil

Kamble et al. (2018) proposed that "Soil" which is non-toxic, inexpensive, obtainable can be employ for development of latent fingerprints on various contrast surfaces. Preparation of soil needs drying before used & should be sieved to get fine powder. It gives good result on all non-porous contrast surfaces due to its property of varicolored abundance in nature. These result advices that various soil powders successfully employ for latent fingerprint development. Pattern

identification can be done in almost all surfaces but level 2 details are not that much clear as compare to other non-conventional powder.

5 - Food color

Rohatgi & Kapoor, 2014 compared a number of powders. Edible food color was one of them. The result of his study shows edible food color as an average powder for developing powder. It does not work well on non-porous, semi-porous or porous surfaces except paper. **Kumari et al. 2011** presented paper on food & festival color. The outcomes are better than those mentioned in the previous paper. In some of the substrate (aluminum foil, sheet) even level 2 details are clearly visible. The results obtained from the application of the food colors can give clear visualization of the ridges and can be a good substitute.

6 - White cement

Garg et al. (2014) presented a paper on a common, frequently available, inexpensive material: White Cement Powder. The study consisted of two parts. First part consists of the development of latent fingerprints. He did the practical by developing latent fingerprint on 20 different substrates by powder dusting method using white cement as developer. In the second part, the ageing of latent fingerprints was studied by developing sets of latent fingerprints after 10 days of interval on 4 different substrates. For a 40-day study on ageing, four sets were made. The effects of using white cement were quite fine. Well defined ridges were observed better than those obtained by conventional powder in 70% of the substrate taken. Remaining was not clearly visible due to poor contrast. Except carbon paper, no other substrate gave better result after 10 days with white cement or white conventional powder. Also no surrounding conditions were mentioned. Overall for latent fingerprint development it proves to be a promising powder.

7- Gram flour

Dhunna et al. 2018 mentioned gram flour as a powder suitable for latent marks development as it gives very fine result on aluminum foil. Level 3 details could also be seen. The gramme flour powder's amylase, which is a crucial component, mixes with the fingerprints' fat component to reveal distinct ridge characteristics. **Jossan et al. 2015** also performed development technique with gram flour on non-porous surfaces in which pattern identification could be done in almost every substrate. More experiments need to be done for establishing the more clarity about this powder.

8 - Coal

After math of **R. Adhithya and Suneetha V. 2015** concluded that coal is best among the others used in the experiment. The best results were obtained using coal powder for both picture development and test finger print elevation. Hence it proved to be a better substitute for fingerprint development than other toxic and costlier conventional powders.

9 - Black pepper

R. Adhithya and Suneetha V, 2015 by crushing pepper seed prepared a fine powder with the aid of mortar and pestle and then a sieve was used to remove the undesirable materials. But the result obtained is still not satisfying. Pattern is visible but not with very much clear ridges.

10 - Limestone

In **Dhunna et al. 2018**, the evaluation after comparing results of different powders on aluminum foil substrate reveal that finer results (clear ridges) were observed with Limestone. Presence of calcite and dolomite in Limestone Powder makes the prints identifiable. Level 1 and level 2 details are easily recognizable.

11- Red chilli

Dhunna et al. 2018 and **R. Adhithya and Suneetha V, 2015** discovered that red chilli powder did not possess appreciable qualities which are adequate for decrypting latent fingerprints. Partial detectable fingerprint pattern were perceived.

12 - Durian seed

Sekar and Zulkifli, 2017 proposed a cheaper and effective powder made with durian seed. Seeds of Durian were rich in starch and will produce white powder. The study conducted on 11 different substrates which indicate that the powder produces distinguishable pattern on non-porous surfaces but did not work effectively on porous and semi-porous surfaces.

13 – Baking powder and baking soda

Jossan et al. 2015 gave positive opinion about baking powder. It gives much better result up to level 2 details in majority of the substrates taken in experiment. **Rohatgi & Kapoor, 2014** take both baking powder and baking soda for the study. Outcomes are little different than previously mentioned paper. Baking soda gives better result i.e. clearer visible pattern, distinguishable ridge characteristics than baking powder in most of the non-porous surfaces.

14 – Corn flour

Jossan et al. 2015 and **Rohatgi and Kapoor, 2014** worked on corn flour, a household material proves to be a suitable powder for exclusion theory i.e. it give pattern visibility through which we can exclude the innocent from list of suspects if they did not poses the pattern appeared on evidence. But due to its natural characteristic, some powder gets stick in furrows as well which gave a foggy image of latent print. Thus it is not suitable for individualization.

15 - Chocolate/Cocoa powder

Jossan et al. 2015 conducted the procedure for developing latent fingerprints on non-porous surfaces where as **Rohatgi and Kapoor, 2014** performed the research work on porous and semi-porous substances. Both of them showed appreciable results as compare to other food powders. Hence it is concluded that cocoa powder is fine substitute of conventional powders.

16 - Festival color

Garg et al. 2011 bring light on festival color (gulal, used in the festival of Holi) as a fingerprint development power for preliminary study. The research shows that festival color could be a substitute for visualizing latent fingerprint. Pattern is deciphered through festival color but ridge minutiae are less distinguishable on various substrate. Thus further studies are required for better estimation about gulal being a promising powder

17 - Silica gel G

Singh et al. 2013 selected a simple accessible and easy on pocketbook powder for decrypting the latent prints – Silica Gel G. The study also compares the effectiveness of silica powder with other conventional powders available like white, black and light grey powder. Interestingly the study conducted results into better decipherment of latent impression on many substrates than conventional powder. The negative results can be seen on white paper, polythene and currency note due to poor contrast. It is concluded from the investigation that silica gel G powder can be used to develop the fingerprint on multi colored surfaces and give equivalent results as those of the conventional powder under the instances of scarcity.

18 - Refined Wheat, Ranipal, custard powder

Jossan et al. 2015 states that all finer powders gives better result than other conventional or non-conventional pointing towards refined wheat, ranipal, custard and baking powder. The development from these powders establishes pattern of the fingerprint beyond doubt but clearer image is not provided which evidently show the ridge minutiae.

19 - Cumin, Coriander, Garam masala and kitchen king powder

Dhunna et al. 2018 speak briefly of cumin, kitchen king, garam masala and coriander powder. In commonly available form, the particle size of each one of them was very large as compare to other household powder which resists giving clearer ridge details. Partial identifiable ridge pattern by Cumin, and less identifiable by Garam Masala Kitchen King, Coriander powder respectively were obtained in latent fingerprint development because of the less adherence properties of the major components of the powders to the sebaceous secretions.

20 - Dry mango, dry ginger powder

Jossan et al. 2015 briefly explained that the two powders did not produce lucid images as their natural form consists of large particle size which prohibits it to get along with the residue of fingerprint on any substrate.

Table 1.2 Qualities of The Latent Fingerprints Developed

A	B	C
Turmeric Powder	Soil	Black Pepper
Fuller's Earth	Coal	Red Chilli
Robin Blue Powder	Durian Seed	Cumin
Food Color	Baking Powder	Coriander
White Cement	Baking Soda	Garam Masala
Gram Flour	Corn Flour	Kitchen King
Limestone	Chocolate/Cocoa	Dry Mango
Silica Gel G	Refined Wheat	Dry Ginger
	Ranipal	
	Custard Powder	
	Festival Color	

In table1.2

A – Development is up to level 2 detail & in some up to level 3 detail with clarity

B – Development is up to level 1 detail i.e. pattern identification is possible but not well defined for ridge minute

C – Less identifiable pattern is observed

Result and Discussion

Further studies on the suitability and applicability of more commonly available powder in finer states is required to be made. However, the results reported in this short paper will give a new direction to the researchers in the field of criminal investigation and will stimulate further investigation to look for much better, less expensive and easily available powders.

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