

# A Comprehensive Review of Fingerprint Development : Exploring Unconventional Powder-Based Techniques

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## ABSTRACT

Fingerprint development remains a crucial aspect of forensic science, aiding in the identification and resolution of criminal cases. This review paper systematically explores the efficacy and potential of various unconventional and natural substances in fingerprint development. Focusing on an array of substances such as turmeric powder, Fuller's clay powder (Multani Mitti), food color, Holi color, durian seeds powder, soil powder, talcum powder, traditional powders, pooja materials, corn seed powder, silica gel G, broccoli powder, medicine powder, salt, sugar powder, and brick powder, this paper discusses their applicability, advantages, limitations, and comparative effectiveness in developing latent fingerprints. The review encompasses studies and experiments conducted to assess the suitability of these substances for fingerprint development across different surfaces and environmental conditions. Additionally, this article examines the environmental and cost-effective benefits of using natural and non-conventional materials in forensic investigations and their sustainability and availability compared to traditional chemical reagents.

**Keywords :** Fingerprint, Forensic Science, Fingerprint development, Powder method.

## I. INTRODUCTION

A fingerprint is a unique identification of individuals. Fingerprint It is a permanent impression of friction ridge's of human skin surface, found on the tip of the fingers, thumbs and palm. One of the best method of human identification. It helps in establishing the identity of the criminals [1]. Based on Locard's principle of exchange, whenever two objects come in contact with each other there is an exchange of

material [1]. This review article is useful for powder methods in fingerprint enhancement. The literature survey reveals that there has been continually an endeavor on the part of the expert to look for a new technique that could show clearer ridge details easily and to be less expensive. Keeping this aspect in view, the present investigation has been undertaken for the visualization of finger marks present on different substrates as it is better to determine if some other powder could be used for the purpose of fingerprint

development particularly in situations when the scarcity of the powder is encountered in the field. Some of the chemical powders used in the fingerprint development are toxic and pose potential health hazards. In order to overcome this disadvantage, an attempt has been made to use non-conventional powders [2].

### 1. Composition

Not two people have the same fingerprint, not even identical twins. These ridge patterns are developed in fetuses between 17 and 19 weeks gestation and they are destroyed after the death of a person. Their composition is a complex mixture of skin secretion and contamination more present in the sudoriferous eccrine, apocrine glands, and sebaceous glands. The sudoriferous gland distributes sweat over the body and produces the sweat more than 98% of water [3]. The secretion of sweat pores and fingerprints are transferred in contact with any object or any other thing. Fingerprint ridges are divided into three categories arch, loop and Whorl

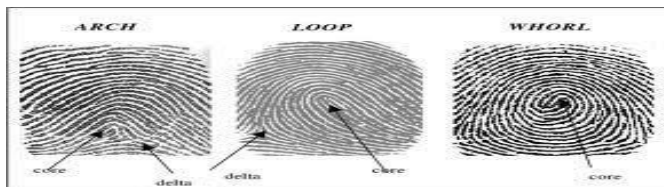


Fig 1 : Fingerprint Ridges [4]

### 2. Surfaces

Fingerprints are used in a person's identity, biometry, and criminal profiling. In forensic science fingerprint play a important role. Evidence identification and collection is the most critical process in crime scene investigation. However the criminal are carefully is to not leave any traces, left behind a set or two of latent fingerprints. Fingerprint evidence found in Visible or latent in various surfaces porous and non- porous. Porous surfaces are absorbant and nonporous surfaces are smooth or rough such as wood , aluminium foil , paper , plastic , still ,copper glass etc. Visible fingerprint are easily visible in necked eyes mud, wax,

clay and soap etc They are collect easily but latent fingerprint are not visible in naked eyes they are developed in various powder or chemical methods. spread the powder and develop to use camel brush. The lipids sweat are left the fingerprint they are help to develop fingerprint. The quality of fingerprint development is depend's on particle size, shape and density of powder [5].

### 3. Methods

There are three methods used for latent fingerprint development. Such as a powder method, chemical method, and fuming method.

The powder method is the old method for fingerprint development. This is the best method and is used widely. Fingerprint powders are relatively inexpensive, making this method cost-effective for law enforcement agencies with budget constraints. Fingerprint powdering provides immediate results. Respectively two powder methods are as follows. Conventional and nonconventional Conventional powder is more effective and expensive. Non - conventional method is low cost, easily available and better results. Non- conventional powder using as

### II. FINGERPRINT DEVELOPING POWDER METHOD

This method is used to make latent fingerprints, which are invisible to the naked eye, visible. It helps investigators and forensic experts identify and examine fingerprint patterns, which can be crucial for solving crimes. By using powder, latent fingerprints can be developed without altering or damaging the underlying surface. This allows investigators to preserve potential evidence for further analysis or court proceedings. The conventional powder method can be used on a wide range of surfaces, including paper, glass, plastic, metal, and even skin. This versatility is valuable in a variety of investigative scenarios. When properly applied, fingerprint powdering is a reliable method for developing

latent prints. It has been used successfully for many decades and is a trusted technique in forensic science. Fingerprint powders are relatively inexpensive, making this method cost-effective for law enforcement agencies with budget constraints. Fingerprint powdering provides immediate results. Once the powder is applied, latent prints become visible, making it a quick and efficient method for initial analysis at a crime scene. The powder method doesn't require complex or specialized equipment, making it accessible to a wide range of law enforcement personnel and forensic experts. Properly trained personnel can use this method effectively. This allows law enforcement agencies to build expertise inhouse, reducing the reliance on external forensic laboratories. Fingerprint evidence developed using the powder method is widely accepted in legal proceedings and can be crucial in establishing a suspect's presence at a crime scene.

### 1. Fingerprint development by Turmeric Powder

A technique for revealing latent fingerprints on a variety of surfaces. The method is uncomplicated, environmentally safe, and can be applied to diverse substrates. The study employs readily accessible and cost effective turmeric powder, a common ingredient. Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant of the ginger family Zingiberaceae [6]. In Indian cuisine, to uncover latent fingerprints on nine distinct surfaces. Using a transparency sheet ,plastic sheet, wooden surface , cd , painted steel , bond paper ,thermal paper .The results demonstrate that this method consistently yields highly distinct fingerprint impressions on most of the surfaces tested [6].



Fig 2 : Turmeric powder for developing fingerprint [6]

### 2. Fingerprint development by food color and holi color

The importance of several factors in effectively revealing fingerprints, including the nature of the prints (sebum and sweat), the surface where they are located, and the techniques employed for print enhancement. In all instances, the ridges in the developed prints consistently appeared distinct. Preliminary observations indicate that everyday substances like food colors and holi colors can be successfully utilized to uncover latent fingerprints on various surfaces, including aluminium foil, aluminium sheets, writing paper, and CD surfaces [7]. Various different colours are used on different porous and non porous surfaces .This are very cheap easily available non toxic and non hazardous for human being . This powder gets very clear and good results and easily developed

### 3. Fingerprint development by Fuller`s clay powder (Multani Mitti)

The presents a new, simple, non-toxic powder coating method that has been used successfully on various substrates to develop and display latent fingerprints for up to 6 days in various application' s . In cheaper, simple and easily available Fuller`s clay powder (Multani Mitti) Fuller's soil is composed of hydrous aluminum silicate in change varying compositions [5]. It's cleaning and adsorption properties. Fuller's clay powder is used as cosmetic skin products [5]. This are easily available, cheap, non toxic and does not hazardous. There was used to decode latent fingerprints on different substrates, such as black cardboard boxes, transparent glass, paper box bar, steel surface, a laminated wood panel. It is observed to give very clear results on the majority of substrates and can be successfully used to develop and display latent fingerprints [5].

### 4. Fingerprint development by durian seeds powder

A new approach to latent fingerprint powder. It solves problems with conventional methods, which

often lose effectiveness after the first week and pose health risks due to toxic chemicals. The solution is to use powdered durian seeds, which are rich in starch, to create a white powder that adheres to fingerprint residue on surfaces choose are aluminium foil ,carbon paper cd, mirror ,steel petri dish microscope, plastic bottle etc. This adhesion is due to hydrogen bonds formed between the fatty acids in sebum and the special ingredients of durian seed powder. This natural powder enhances the visibility of fingerprints a potentially play an important role in analyzing old fingerprints at crime scenes. It is non-toxic, safe, readily available and cost-effective [8].

### **5. Fingerprint development by traditional powder**

Traditional methods for developing latent prints using various powders have been the standard practice in forensic investigations, there have been recent advancements in techniques. Investigators typically rely on these traditional powder-based methods as their primary means of uncovering latent prints at crime scenes. That using commercially available substances such as Natural Henna, Vermilion, Gram Flour, and Coffee Powder can significantly enhance and intensify latent prints. This discovery presents a new approach to latent print development at crime scenes, supplementing the traditional methods. The prints using these unconventional substances were notably clear, identifiable, and provided valuable information about the suspects' identities when visualized [9].

### **6. Fingerprint development by soil powder**

When different surfaces for their contrast qualities, this method demonstrates favorable outcomes. The effectiveness of soil powder in revealing otherwise invisible fingerprints can be attributed to the formation of non-covalent bonds between the soil powder and residual components of latent fingerprints. Latent fingerprints treated with soil powder on surfaces such as CPUs, CDs (both front and back), and glossy tabletops can serve for personal identification

in cases involving theft, robbery, murder, and dacoit crimes. Importantly, when latent prints were developed using soil powder on the writable surface of CDs, the data contained therein remained intact and unaffected [10].

### **7. Fingerprint development by talcum powder**

The latent fingerprints is crucial in crime scene investigations as they hold unique identities of individuals involved in the crime. Powder coating is ideal for developing latent prints on non-porous and semi-porous surfaces. In this study, talcum powder was used to decode fingerprints on various surfaces. Talcum powder contains magnesium, silicon, and oxygen. It is used in skincare products to reduce friction and absorb moisture, keeping the skin dry and rash-free in humid conditions [11].

Commonly found in daily life. This powder is cheap, safe, and readily available in stores. The powder produces high-quality fingerprints on metallic surfaces, copper foil currency coins, door latches, locks, etc surfaces. Is a viable alternative to traditional powders [11]. This powder gives good results fingerprint ridges are clear on dark surfaces.

### **8. Fingerprint development by pooja materials**

The hands and feet have raised edges, also known as papillary or epidermal edges, on the surface. The edges flow in different directions. These edges have small pores that emit sweat from the skin's eccrine organ [12]. Comparative evaluation of latent fingerprint evolution on different surface colors. Powder is great for revealing hidden fingerprints on surfaces. Various shades and types of powder have been utilized, including Pooja powders, as white surfaces can darken. Developing latent fingerprints are cheap and found in every Indian home. Such as using ashtgandha ,ash ,white abir ,and Kumkum. If a crime has occurred and investigators lack a fingerprint development kit, they can use household items for fingerprint development [12]. comparison of fingerprints developed with different colors on



surfaces. Powders are used to make fingerprints invisible on different surfaces. Pooja powder is used based on the surface color - dark powder for white surfaces and light powder for dark surfaces. This helps in creating effective and undetectable fingerprint impressions for examination [12].

### 9. Fingerprint development by corn seed powder

To replace expensive, toxic, and intricate powders, there is a need to identify an affordable, non-toxic, and readily available alternative. This method utilizes corn seed powder for visualizing latent fingerprints, aiming to determine the most cost-effective and accessible household powder commonly found in Indian homes for fingerprint development. The results indicate that a significant number of rigid cases exhibited distinct ridge details on various surfaces when compared to cases where non-conventional powders were used [13].

### 10. Fingerprint development by silica gel G

Fingerprints are crucial physical evidence found in many crime scenes. Inactive fingerprints are a mixture of emissions and contaminants found on the edges of the finger or palm. These emissions come from three types of skin organs: sudoriferous eccrine, apocrine, and sebaceous organs. These organs have defined capacities and their emissions change as a result [3]. In latent fingerprint used silica gel G powder this are available in laboratories for prepare the TLC plates. Silica gel G powder is a form of silicon dioxide (silica) with the binder gypsum [3]. The silicon atoms are joined via oxygen atoms in a giant covalent structure [3]. At the surface of the silica gel, the silicon atoms are joined to -OH groups. This powder methods result are observed clear ridges on using the contrast surfaces are plastics, glass, ordinary mirror, aluminium foil sheet, carbon paper, currency notes etc. Silica gel powder is expensive, easily available [3].



Fig 3 : Silica gel G powder for fingerprint development [3]

### 13. Fingerprint development by Salt & Sugar Powder

The different salt like table salt powder, rock salt powder, smoked grey salt powder and sugar powder are readily available household items. These common products can be found in virtually every home, making food easily available. In the event of a crime, when investigators arrive at the scene without fingerprint development powders, they can conveniently employ these household powders to reveal fingerprint impressions. The application of salt and sugar powders yields successful results on a book surface, metal, CPU, plastic, lock etc of surfaces during crime scene investigations. This technique can be employed right at the crime scene to bring out hidden fingerprints [14].

### 14. Fingerprint development by Brick Powder

Unique fingerprint identification is a method of identification using the pattern formed by the tiny ridges on the fingertips. Fingerprints have distinct individual characteristics. Idle fingerprints are typically seen prints from the crime scene. The prints are invisible and difficult to detect and protect. In this paper, a new method using brick powder is used to enhance Idle fingerprints. The brick powder is used on various surfaces like plastic glass, reflect, matchbox, painted wall, CD, wooden surface, currency note, door handle, floor, book cover, shades, and glass card to enhance fingerprint impression. This powder are better result on light and dark surfaces [15].

### III.CONCLUSION

In conclusion, this comprehensive exploration underscores the significant potential of unconventional and natural substances in advancing fingerprint development within forensic science. Through an in-depth analysis of diverse substances, including turmeric powder, Fuller's clay powder (Multani Mitti), food and Holi colors, durian seeds powder, soil powder, talcum powder, traditional powders, pooja materials, corn seed powder, silica gel G, broccoli powder, medicine powder, salt, sugar powder, and brick powder, we have elucidated their varied applicability, advantages, limitations, and comparative effectiveness in revealing latent fingerprints. Our review consolidates empirical studies across various surfaces and environmental conditions, shedding light on the chemical mechanisms underlying their interaction with latent fingerprints, ultimately enhancing contrast and visibility. Importantly, this exploration emphasizes the environmental and cost-effective advantages of these materials over traditional chemical reagents, underlining their sustainability and accessibility. The emphasis on ease of use serves to highlight the practicality and feasibility of integrating these substances into forensic investigations. However, acknowledging the challenges associated with their use, we envision promising avenues for future research and development, aiming to address these limitations and refine methodologies further.

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