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Impana R
Garden City University,
Bangalore, Karnataka, India

Priyanka Gupta
Akali Degree College, Sangrur,
Punjab, India

Mehnaz S
Department of Science,
Garden City University,
Bangalore, Karnataka, India

Devadharshini R
Department of Science,
Garden City University,
Bangalore, Karnataka, India

Corresponding Author:
Impana R
Garden City University,
Bangalore, Karnataka, India

A study on development of fingerprint powders using natural sources for latent fingerprint visualization on non-porous surfaces

Impana R, Priyanka Gupta, Mehnaz S and Devadharshini R

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Abstract

The fingerprint development methods are the cornerstone of forensic science. The powder dusting method is a popular and non-destructive method for detecting latent fingerprints. This study aimed to find cheap, safe and readily available alternatives to the traditional powders. The creation and application of fingerprint powders derived from natural sources. These environmentally safe alternatives pigments and compounds created from natural materials highlight their potential adhesive capabilities for fast fingerprint viewing. In this study we used a non-porous surfaces like smartphone screen, white ceramic plate for the background for developing and visualization of the fingerprint impression. Among the various powders used, betel leaf powder and turmeric powder emerged as a promising material for the detecting the latent fingerprints. The productiveness of charcoal powder was also magnificent. orange peel powders and beetroot powder have been delineated to be poor fingerprint powder. The purpose of this research is to investigate the feasibility and effectiveness of using these natural powders in forensic investigations, as well as to emphasize their contributions to sustainable and ecologically conscientious crime scene analyses. This research opens doors for further exploration of unconventional, safe, and affordable fingerprint powder.

Keywords: Natural based fingerprints powders, latent fingerprints, non-porous surfaces, betel leaf powder, turmeric powder, charcoal powders

Introduction

A fingerprint is an impression made by the friction ridges on a human finger (Kapoor, Moon N, Pardeshi P. *et al.*, 2023) [1]. The recovery of partial fingerprints from a crime scene is an essential forensic science technique (Harush-Brosh. Y, Hefetz I, *et al.*, 2020) [2]. Fingerprints on surfaces such as glass or metal are caused by moisture and grease on the finger (Bhati, Kajol, Divya Bajpai Tripathy, *et al.*, 2023) [3]. Ink or other substances transferred from the peaks of friction ridges on the skin to a flat surface such as paper can be used to create deliberate impressions of whole fingerprints. At a crime scene, forensic investigators detect fingerprints by dusting surfaces with dark powders that adhere to the prints (Sodhi G.S, Kaur. J, *et al.*, 2001) [4]. If they locate any, they can remove the prints with transparent adhesive tape. While this can aid investigators in determining whether a suspect was present at the crime scene (Remi Wieten, Jacob De Zoete, *et al.*, 2015) [5]. Fingerprint powders are fine powders used by crime scene investigators and other law enforcement professionals in conjunction with fingerprint brushes to search for and enhance latent/invisible fingerprints that can be used to determine identity.

Different types of fingerprint powders used in the crime scene are: black, white, grey powders, magnetic powders, fluorescent powders, granular powders, luminescent powders, nano powders, biochromatic powders.

Fingerprint powders used in the past contained materials that were considered carcinogenic and toxic. In particular, lead and mercury components were removed from fingerprint powders due to associated cases of mercury lead poisoning (Van Netten C, Souter F, *et al.*, 1990) [6]. Modern fingerprint powders pose significantly fewer health risks because they are composed mainly of organic component (Dhunna, A., Anand, S, *et al.*, 2018) [7] however, there is concern that the small particles within the fingerprint powders may be inhaled and after prolonged exposure can result in the development of lung diseases (Si, Xiuhua, Jinxiang Xi, *et al.*, 2021) [8].

Previously utilized fingerprint powders contained compounds that were thought to be cancerous and poisonous (Eswaran Prabakaran, Kriveshini Pillay, *et al.*, 2021) ^[9]. Because of the linked occurrences of mercury lead poisoning, lead and mercury components were eliminated from fingerprint powders (Brodkin E, Copes R, *et al.*, 2007) ^[10]. Modern fingerprint powders represent substantially fewer health dangers because they are primarily formed of organic components (Balan V, Mihai CT, *et al.*, 2019) ^[11] however, there is concern that minute particles inside the fingerprint powders may be breathed, resulting in the development of lung disorders after extended exposure.

Smaller particle size powders, such as fluorescent powders or the newer nano powders, are more dangerous since they can reach and settle deep into the lungs (Smola M, Vandamme T, *et al.*, 2008) ^[12]. Individuals who frequently use these powders should thus take the required precautions to reduce the risk of respiratory illness, such as working in a fume hood or wearing a mask. Natural fingerprint powders, such as plant-based compounds or minerals, provide an environmentally safe and sustainable alternative to conventional chemical powders (Ramanan Vadivel, Muthukumaran Nirmala, *et al.*, 2021) ^[13]. These powders can be created by extracting pigments or chemicals with adhesive qualities, which increases their efficacy in lifting and seeing fingerprints. This advancement is in line with the increased desire for environmentally friendly forensic techniques that retain accuracy in crime scene investigations.

Materials and Methodology

- We tried implementing a lot of naturally available raw resources in manufacturing fingerprint powders by using (betel leaf, turmeric, beetroot, orange peel) and tried on non-porous surface like (Mobile screen, white board, painted surfaces, white ceramic plates) got both positive and negative results.
- Lime stone was another major material used in preparation of the following fingerprint powders
- Later the developed fingerprint samples were collected using photographic method using the 48Mp 1/2" Quad-Bayer sensor (12Mp output resolution), 26mm-equivalent f/1.75-aperture lens, PDAF and laser AF Mobile camera lens.

Methods

The below mentioned fingerprint powders were prepared using natural resources.

Betel Leaf Powder

- We took 10 betel leaves and washed thoroughly with water such that there is no contamination in it.
- The betel leaf was finely grounded along with lotus lime
- Then the paste was made to dry under sunlight for about 24hours
- Then this powder was finely crushed in a mortar to avoid lump formation
- Then this powder was sieved and the fine powder was extracted
- The finger print development process was carried out using this powder
- We could easily observe the fingerprints on non-porous

surfaces

- This powder gave positive result on mobile screen (nonporous surface).

Turmeric Powder with Lotus Lime

- Take turmeric rhizome and dried it completely and finely powdered
- Add lotus lime to this powder along with lemon juice
- Mix it thoroughly and allow it to dry under sunlight
- Then grind the powder such that there are no lumps in it
- Sieve this mixture and extract the fine powder
- We used this powder for developing fingerprint on nonporous surface
- This powder gave positive result on mobile screen (Nonporous surfaces)

Beetroot Powder

- Two complete beetroots were taken and grated finely
- Remove the excess water and collect the solid part
- Dry it thoroughly under sunlight for about 72 hours such that no moisture is present in it
- Grind the sample thoroughly using mortar and sieve it completely such that fine powder is obtained
- This powder was used to develop fingerprint on non-porous surface

Charcoal Powder

- Charcoal is obtained
- Then grind the solid charcoal thoroughly
- The grounded charcoal was sieved to remove the solid particles and fine powder was collected and used as fingerprint developing powder
- This powder was used to develop the fingerprint on a non-porous surface

Orange Peel Powder

- Orange peels were collected and washed thoroughly
- Then dried under sunlight at least for 7 days
- Finely grind the dried orange peel completely
- Sieve the powder such that no obstacles were present
- Collected the fine powder and used for fingerprint developing pro

Result and Discussion

The latent fingerprint on non-porous surfaces such as a mobile screen and a white ceramic plate can be successfully inspected using betel leaf powder, turmeric powder with lotus lime, and charcoal powder. Where this powders likely adhere well to the sweat and oils deposited by fingerprints on the surfaces, making the ridges visible. These powders were shown to produce clear results on contrast surfaces. The latent fingerprint present on surfaces such as a smartphone screen and a white ceramic plate was produced and revealed obvious ridges in the sample used in this experiment.

Latent fingerprints were not developed on the mobile screen and a white ceramic plate when beetroot powder and orange peel powder were used. where these powders were potentially contrasting in colour, proved ineffective for fingerprint development, this suggest that colour alone may not be the sole determinant of success. The particle size, adhesiveness, and interaction with fingerprint residue likely play a role.

The research emphasizes the importance of surface type. The success on mobile screens and whiteboards suggests these surfaces may retain fingerprint residue more readily or offer better adherence for the effective powders. Further investigation into the compatibility of these powders with different non-porous materials like (glass, metal) would be valuable.

The further directions of these study are understanding the precise mechanism by which these natural powders interact with fingerprint residue would allow for targeted development of even more effective fingerprint visualization methods.

Optimizing the particle size, concentration, and application methods of these natural powders could improve their efficacy and consistency. additionally, standardizing application protocols would enhance the reliability of this technique in forensic settings.

The use of natural, potentially biodegradable friendly alternative traditional fingerprint development methods that may rely on harsher chemicals,

This study paves the way for further exploration of natural alternatives for latent fingerprint development on non-porous surfaces. By understanding the underlying mechanisms and optimizing the techniques, these natural powders could become a valuable tool for forensic investigations, particularly in resource limited settings.

Fingerprints developed using above prepared Natural Fingerprint powders



(i) phone screen (ii) White Ceramic plate

Fig 1: Fingerprints developed on different surfaces using Turmeric Powder



(i) White Ceramic plate (ii) phone screen

Fig 2: Fingerprints developed on different surfaces using Charcoal Powder



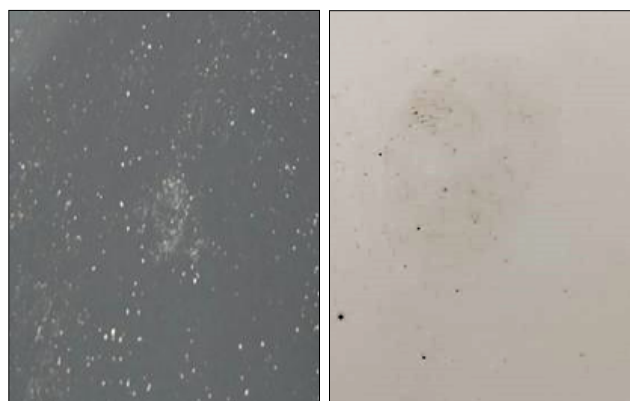
(i) phone screen (ii) White Ceramic plate

Fig 3: Fingerprint developed on different surfaces using Betel leaf Powder.



(i) phone screen (ii) White Ceramic plate

Fig 4: Fingerprint developed on different surfaces using Beetroot Powder.



(i) phone screen (ii) White Ceramic plate

Fig 5: Fingerprint developed on different surfaces using Orange peel Powder

Conclusion

According to the findings of this study, the different forms of natural resources is used, the resources which are used here are the household products, which has been these easily manufactured, non-toxic, and user-friendly materials could be effective for producing latent fingerprints imprinted on various non-porous surfaces. In comparison to chemical powder, instances of shortage, this natural source fingerprint powder can be used for latent fingerprint development and

visualization. The main idea of this research is to explore using naturally available resources for latent fingerprint development powders in situations where proper forensic equipment is unavailable, the simplicity of this technique is its uncomplicated and it doesn't require specialized training, in a view of benefits to criminal justice system this method, if proven reliable, and could aid in solving crimes by allowing for fingerprint identification even in situations with limited resources.

The results of this research are the powders like betel leaf, turmeric and charcoal can find fingerprints on smooth surfaces, making the fingerprint patterns to visible and other powders like beetroot and orange peel don't work showing colour isn't the only factor. The size, stickiness and how the powder interacts with fingerprint residue are probably important too.

This research suggests that the effectiveness of naturally available resources on various surfaces needs to be evaluated. The scope for further enhancement on fingerprint powders using natural sources includes improving material selection, developing better formulation, exploring new application techniques, ensuring compatibility with surface.

Conflict of Interest

Not available

Financial Support

Not available

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