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Original Research

Development of latent fingerprints using indigenous unconventional methods

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Abstract: Introduction- The fingerprint is the most useful form of evidence that can be found at the crime scene. It helps in establishing the identity of the criminal. Criminals nowadays are quite aware of the importance of the significance of fingerprints found in the crime scene, therefore they make all possible efforts to erase the prints from the scene. Despite such efforts, chance prints are often left behind in the scene. Chance prints mostly are latent and require thorough development procedures to use for convictions. Several well-known methods of development already exist in the literature but are not very cost-effective.

Materials and Methods- This study explores unconventional methods for developing latent prints, investigating their effectiveness using various substances and considering environmental factors. The different powders used for this study were Banana Powder, Asafetida Powder, fenugreek powder, Milk Powder, Beetroot Powder and Neem Powder. All powders were tried on both porous and non-porous surfaces to assess the results.

Result and Conclusion- The research's implications are significant for forensic science, aiding in perpetrator identification, exoneration of suspects, and DNA evidence preservation. The study concludes that Banana powder and Beetroot powder are effective in developing prints on porous surfaces.

Introduction: The fingerprint is the most useful form of evidence that can be found at the crime scene. It helps in establishing the identity of the criminal. Fingerprints are unique for every person and cannot be changed throughout his life. According to Locard's principle of exchange, there is an exchange of material whenever two objects come in contact with each other. At the crime scene, a finger touches any object, fingerprints are left over the object because of sweat and oil on the skin surface[1]. Fingerprints are a crucial form of evidence at crime scenes due to their uniqueness and the principle of exchange proposed by Locard. There are three main types of fingerprints:

- Visible fingerprints: These are easily seen with the naked eye and can be directly collected.
- Plastic fingerprints: These are imprints left in pliable substances like wax or clay, requiring special casting methods for collection[2].

- Latent fingerprints: These are invisible to the naked eye and necessitate additional development techniques for visualization.

Latent prints are the most common at crime scenes and can be found on various surfaces, both porous and non-porous[3]. The method used to enhance latent prints depends on the type of surface they are found on. Fingerprints are commonly available on the crime scene objects, but may not be visible to naked eye. Optical methods are choice of method for locating the fingerprints and powder method is the most common method used for development of the latent prints. There are a variety of commercial conventional powders available for the purpose, but unconventional powders specially are noteworthy as they are eco-friendly. The efficacy of a powder depends on the fineness of the powder particles. Finer the grains, better will be the results.

Fingerprint patterns are based on friction ridges and fall into three main categories:

- Loops: These prints form a loop shape by curving back on themselves and can be further divided into radial loops and ulnar loops, constituting around 60% of all patterns.
- Whorls: Whorls create circular or spiral patterns, including plain central pocket loops, double loops, and accidental loops, making up about 35% of pattern types.
- Arches: Arches form a wave-like pattern and can be plain or tented, with tented arches having a sharper point. Arches account for about 5% of pattern types.

Surfaces on which fingerprint develops: Porous surfaces

Porous surfaces are areas covered with highly porous material that allow water from precipitation to pass through, yet are strong and durable enough to support vehicular or pedestrian traffic[4]. Examples include paper, cardboard, and untreated woods

Non-porous surfaces

Non-porous surface means a smooth, unpainted solid surface that limits penetration of liquid-containing PCBs beyond the immediate surface[5]. Examples of hard nonporous surfaces include stainless steel, metal, glass, hard plastic, and varnished wood.

Semi porous surfaces: Semiporous surfaces are characterized by their nature to both resist and absorb fingerprint residue. Fingerprint residue on these surfaces may or may not soak in because of the absorbent properties of the substrate and

the variable viscous properties of the fingerprint residue[6]. These surfaces include glossy cardboard, glossy magazine covers, some finished wood, and some cellophane.

Conventional procedures used by the latent print examination include dusting, iodine fuming, silver nitrate development, and ninhydrin treatment. Newer techniques, such as metal vacuum deposition and autoradiography, are usually not feasible because they require complex instrumentation and considerable technical expertise[7]. Latent print fluorescence, dusting with fluorescent powders, staining with fluorescent dyes, and treatment with compounds such as fluorescamine can produce satisfactory prints. Because the laser method is new, only a few law enforcement agencies use it[8].

The significance of fingerprints in forensic science can be attributed to the following reasons:

Identification Fingerprint analysis is used to identify individuals involved in crimes. Fingerprints found at crime scenes can be matched with those in criminal databases, leading to the identification and apprehension of suspects[9]. Exclusion is Fingerprints can also be used to exclude innocent individuals from suspicion. When fingerprints found at a crime scene do not match those of a suspect, that person can be excluded from the investigation.

Material and Methods: All the samples were collected from different surfaces (porous and non-porous) at room temperature. Marble and Glass surface was used for non porous surface and paper was used for porous surface. Relatively humidity was moderate and the sweating rate was low. The powder dusting method was used to visualize the latent prints[10]. For this purpose, unconventional powders were used. When the powder was tested over the surface, it adhered to the sweaty part of latent prints. Then the extra powder was dusted off. Consent was obtained from all participants. A comparative study was done based on the results obtained. The following powders were used to develop the latent fingerprint impressions[11,12].

Fenugreek Powder: Fenugreek is an annual plant in the family Fabaceae with leaves, consisting of three small obovate to oblong katlets. It is cultivated worldwide as a semiarid crop. Its seed and leaf are common ingredients in dishes from the Indian sub-continent and have

been used as a culinary ingredient since ancient times.

Asafoetida Powder: Asafoetida is the dried latex exuded from the rhizome or tap root of several spices of ferula, perennial herbs growing 1 – 1.5 meters tall. They are part of the celery family, umbelliferae.

Milk Powder: Powdered milk also called milk powder, is a manufactured dairy product made by evaporating milk to dryness. One purpose of drying milk is to preserve it. Milk powder has a far longer shelf life than liquid milk and doesn't need to be refrigerated due to its low moisture content.

Beetroot Powder: Beet powder also called beetroot powder is a similarly bright pink or red product made from dried ground beets. Beet powder is often advertised as a superfood and sold by natural retailers.

Banana Powder: Banana powder is a powder made from processed bananas. It is used as a component for the production of milk shakes and baby foods. It is also used in the manufacture of various cakes and biscuits.

Neem Powder- Neem powder is an integral part of Ayurvedic medicine and it is used to balance pitta and kapha dosa and treatment of vata disorders. Neem leaf powder purifies the blood, battles free radical damage, flushes out toxins, treat insect bite, and cures ulcers.

The prints were developed using a feather brush in the Forensic Laboratory of Annai Fathima College of Arts and Sciences. The Asafoetida Powder and Fenugreek Powder were homemade and others (Neem Powder, Beetroot Powder, Banana Powder, Milk Powder) were purchased commercially.

Please refer here Table 1: Summary of the development of the prints using different unconventional powder methods.

Results and Discussion: Results of the current study show that the latent fingerprints were developed using unconventional powders on different surfaces. Some powders give better results from porous surfaces and non-porous surfaces. **Please Refer to**

Asafoetida Powder: Marble: A visible print was found but it did not give clear ridges.

Glass: A more clear and visible print was formed on the surface.

Paper: No visible print was formed.

Fenugreek Powder: Marble: A visible print was formed on the surface and the ridge pattern was visible and easily identified by the naked eye.

Glass: A visible print was formed

Paper: No visible print was formed.

Milk Powder

Marble: No visible print was formed.

Glass: No visible print was formed.

Paper: No visible print was formed.

Beetroot Powder

Marble: A visible print was formed on the surface and the ridge pattern was visible and easily identified by the naked eye.

Glass: A visible print was formed on the surface and the ridge pattern was visible and easily identified by the naked eye.

Paper: A print was slightly formed and cannot identified by the naked eye.

Banana Powder

Marble: A visible print was formed on the surface and the ridge pattern was visible and easily identified by the naked eye.

Glass: A visible print was formed on the surface and the ridge pattern was visible and easily identified by the naked eye.

Paper: A print was slightly formed and cannot identified by the naked eye.

Neem Powder

Marble: A visible print was formed and the ridge pattern was visible and easily identified by the naked eye.

Glass: It gives a better result of the glass surface and the ridge patterns were visible and identified by the naked eye.

Paper: A visible print was formed and the ridge patterns are easily identified by the naked eye.

Please refer here Table 1: Summary of the development of the prints using different unconventional powder methods.

Please refer here Table No. 1

Discussion: This study has come up with novel and innovative dusting powders that have shown momentous outcomes with the metal substrate[13]. This type of work has not been reported previously and can provide beneficial information to the sleuths in cases of death or the non-availability of orthodox fingerprint development powders and chemicals[14].

Developing latent fingerprints using unconventional methods is an interesting and important topic for a dissertation[15]. Traditionally, developing latent fingerprints has been done using chemical and physical methods. However, many unconventional methods have been developed in recent years that offer new and potentially more effective ways of developing latent fingerprints[16].

Milk Powder gives no results in both Porous and non-porous

surfaces. Asafoetida Powder and Fenugreek Powder give better results on non-porous surfaces and both of them give no results on porous surfaces. Beetroot Powder and Banana Powder also give better results on non-porous surfaces and both of them give partially visible prints on porous surfaces. From Six Powder, Neem Powder gives better results in both non-porous and porous surfaces and we can suggest Neem Powder to experts because it will give visible prints with clear ridges. The study published by Amit Chauhan et al (2017) proves that unconventional powders can also give satisfactory results in latent print development. They concluded natural henna powder has a success rate of 93.33% over other powders used.

One unconventional method that has gained popularity in recent years is the use of nanotechnology[17]. Nanoparticles can be used to enhance the contrast between the fingerprint and the surface on which it is deposited. For example, gold nanoparticles have been used to develop latent fingerprints on non-porous surfaces such as glass and plastic. Another example is the use of silver nanoparticles to develop latent fingerprints on porous surfaces such as paper and cardboard[18].

Another unconventional method that has been developed is the use of electrostatics. Electrostatics can be used to lift latent fingerprints from surfaces without the use of chemicals[19]. This method involves charging the surface and then using an electrostatic dusting apparatus to collect the charged particles that adhere to the fingerprint. This method is particularly useful for developing latent fingerprints on delicate surfaces where chemical methods could damage the evidence[20].

The advantage of using unconventional methods is that they can be more environmentally friendly than traditional chemical methods. Many chemical methods involve the use of toxic chemicals, which can have negative impacts on the environment and pose health risks to investigators. Unconventional methods that use biological materials or alternative physical methods, such as electrostatics, can be safer and more sustainable alternatives[18].

It is important to note that unconventional methods may have limitations and drawbacks that should be taken into consideration. For example, some methods may require specialized equipment and expertise, and some

may not apply to all surfaces or types of fingerprints.

Additionally, some unconventional methods involve the use of biological materials, such as bacteria and enzymes, to develop latent fingerprints. For example, bacteria can be used to develop latent fingerprints on surfaces such as wood and fabric. Enzymes can be used to enhance the contrast between the fingerprint and the surface on which it is deposited

Overall, developing latent fingerprints using unconventional methods is an interesting and promising area of research. It has the potential to improve the efficiency and accuracy of fingerprint analysis and could have important implications for forensic science

CONCLUSION: Developing latent prints is a crucial part of forensic investigations. These prints are often invisible to the naked eye and require specific methods and techniques to be made visible. Traditionally, forensic investigators have used a limited range of methods, such as dusting, ninhydrin, or cyanoacrylate fuming, to develop latent prints.

However, the development of new methods using unconventional materials and substances, such as household chemicals, dyes, or gold nanoparticles, has opened up new possibilities for forensic investigations. These methods can provide better results on challenging surfaces, including those that are wet, dark, or porous. They can also be more cost-effective and easier to use, making them accessible to forensic professionals with limited resources. For example, household chemicals such as vinegar, iodine, or baking soda, can be used to develop latent prints on paper or other porous surfaces. These substances react with the compounds in the print residue, causing it to become visible. Similarly, the application of gold nanoparticles can enhance the visibility of latent prints on a variety of surfaces, including skin, plastic, or metal.

While these unconventional methods have shown promising results, they also have limitations that must be considered. For example, not all surfaces may be amenable to unconventional methods, and some methods may require specialized training and equipment. Additionally, the results obtained from these methods may not be admissible in court, and their use must be supported by appropriate validation studies.

Therefore, it is essential to continue researching and developing unconventional methods for developing latent prints. Validation studies must be conducted to establish the reliability and effectiveness of these methods, and appropriate standards must be established to ensure their admissibility in court. Ultimately, the use of unconventional methods for developing latent prints has the potential to enhance the accuracy and efficiency of forensic investigations and contribute to the resolution of criminal cases.

The unconventional powders are non-toxic and very easy to use as Compared to conventional powder. Even unconventional Powders provide better results on surfaces for developing Latent fingerprints. These powders are much more effective Than conventional methods as such techniques are costly and toxic.

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Tables and Figures: IJMJ-2023-112

Figure 1-5 here

Figure 1: Development of Latent Fingerprint with the help of Asafoetida powder on a Non-Porous marble surface

Figure 2: Development of Latent Fingerprint using Fenugreek powder on Non Porous marble surface

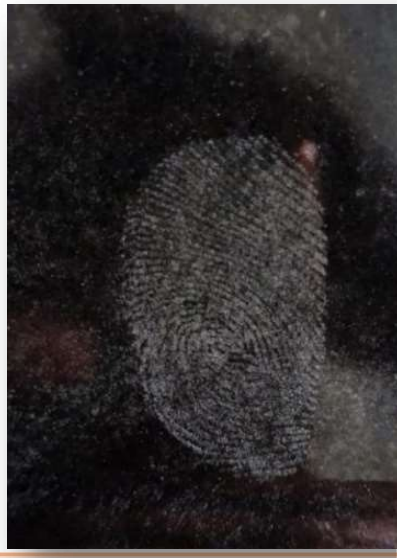

Figure 3: Development of Latent Fingerprint using Beetroot powder on Non Porous marble surface

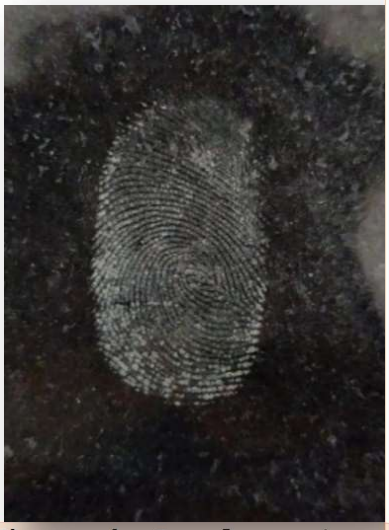

Figure 4: Development of Latent Fingerprint with the help of Banana powder on a porous marble surface

Figure 5: Development of Latent Fingerprint with the help of Neem powder on a porous marble surface.

Table 1: Summary of the development of the prints using different unconventional powder methods

Surface	Powder Used	Results
Non Porous Surface -	Asafoetida Powder	Fingerprint developed

Marble	Fenugreek Powder Milk Powder Beetroot Powder Banana Powder Neem Powder	Fingerprint developed Fingerprint not developed Fingerprint developed Fingerprint developed Fingerprint developed
Non Porous Surface - Glass	Asafoetida Powder Fenugreek Powder Milk Powder Beetroot Powder Banana Powder Neem Powder	Fingerprint developed Fingerprint developed Fingerprint not developed Fingerprint developed Fingerprint developed Fingerprint developed
Porous Surface – Paper	Asafoetida Powder Fenugreek Powder Milk Powder Beetroot Powder Banana Powder Neem Powder	Fingerprint not developed Fingerprint not developed Fingerprint not developed Fingerprint developed but ridge characteristics not prominent Fingerprint not developed Fingerprint developed but ridge characteristics not prominent Fingerprint developed