JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Development of dark powder by coconut spathe ash for latent fingerprint visualization

[1]Prem Ranjan Kumar, [1*]Hritik Kumar, [1*]Shanu Kumar

[1]M.Sc. in Forensic Science, Jharkhand Raksha Shakti University, Ranchi, India
[1*]Assistant Professor, Jharkhand Raksha Shakti University, Ranchi, India
[1*] Assistant Professor, Jharkhand Raksha Shakti University, Ranchi, India

Abstract: Fingerprints are one of the most frequently found evidence in crime scenes and are widely recognized as a tool for human personal identification. The nature of fingerprints varies at the scene of the crime on a circumstantial basis such as visible, three-dimensional, and latent fingerprints. The latent prints require the use of imaging techniques. Among the established routine methods for fingerprint development is the use of commercially available black and white powder. Although this method is relatively fast, simple, and cheap, but can cause harmful hazards and health risks to users due to the use of fine particles such as titanium dioxide, lead, and mercury-based powders. Therefore, there is a growing need to find alternate powders that are easy to prepare, cost-effective, and non-toxic in nature. This study proposes to develop an alternate powder that can be produced by the ash of coconut spathe that is considered as a waste of coconut fruit, it is a much cheaper, simple, and readily available option. The finding of the study revealed that the ash of coconut spathe is capable of visualizing latent fingerprints on both porous and non-porous surfaces such as sun mica, glass, marble, metal, tiles, plastic, paper plaster walls, etc. The frictional ridges were very clear and all the minutiae can be used for comparison and record purposes. This study also opens up the scope of further study in this way.

Keywords: Latent fingerprint, coconut spathe, crime scene, toxic, fingerprint powder.

I. INTRODUCTION

Fingerprints are the most common form of physical evidence found at a crime scene. They're formed when the friction ridges on our fingers come into contact with an object or surface, leaving behind their unique impression. Because fingerprints are highly individualized, they're primarily used as a tool for strong person identification in forensic investigations. Whenever a person touches, holds or picks up an object, there's a high chance of transfer of their fingerprints onto the surface. Fingerprints can be classified based on their visibility as latent (invisible), visible, or plastic prints. While finding visible or plastic prints at a crime scene is relatively easy, finding hidden or invisible prints requires specialized imaging and development techniques. There are several methods for visualizing latent fingerprints, and the choice of method depends on the surface being investigated, ease of use, efficiency, and safety, among other factors.

Powder dusting is a physical enhancement method that uses fingerprint powder to enhance the moisture and oil components of the ridges on the fingers. The adhesion efficiency of the powder prints depends on the particle size and shape, among other factors. Smaller and finer particles tend to stick more easily than larger and rougher ones.

Researchers have previously used various conventional, unconventional, and commercially available powders, dyes, and pigments to create latent fingerprints. However, the majority of conventional methods use potentially hazardous chemicals during development. To overcome this limitation, some researchers have also used plant powders like Genipin, banana peel activated carbon, turmeric powder, and *Imperata cylindrical* to develop latent fingerprints.

In this study, we demonstrate the use of Spathe powder to visualize latent fingerprints. Coconut spathe is the covering of the coconut inflorescence, which is a flowering structure. Due to its non-toxic nature, wide availability, and simple production process, we aimed to develop an affordable and naturally occurring fingerprint powder from coconut spathe to visualize latent fingerprints on porous and non-porous materials such as mirrors, glass, tiles, metal, marbles, sun-mica, gypsum board, and wallpaper.

II RESEARCH METHODOLOGY

Materials:

Coconut spathe (from a home garden), matchstick, mortar pastel, scissors, sieve, gloves, substrate (such as glass, plastic, sun mica, metal plate, tiles, board paper), fingerprint brush, and a sample.

Preparation of powder from coconut spathe:

In this study, we have developed a novel fingerprint powder from coconut spathe. Firstly, the dried coconut spathe is collected from the home garden and the unwanted parts are removed. Then, it is allowed to burn without the use of any accelerant. After that, it is Kept at room temperature for cooling. The ash is then ground using a mortar pastel to make the particles very fine and then sifted through sieves of size 0.45mm. Finally, the ash is stored in a plastic container under dry conditions.

Collection of latent fingermarks:

For this study, we collected latent fingerprints from fifty donors (20 males and 30 females) between the ages of 20-40 years. We ensured that the donors did not have contact with food or chemicals, had not worn gloves, and had not washed their hands in the preceding one hour prior to depositing their fingermarks. The fingermarks were obtained in natural condition, without any grooming to increase the amount of sebum on the finger-pads. The donors were instructed to sequentially apply their finger-pads to separate areas of the dictated surface type with light pressure.

Visualization of latent fingerprint:

We deposited a total of fifty fingerprints from consented donors on nine surfaces, including three porous surfaces (gypsum board, wall, paper) and six non-porous surfaces (mirror, glass slide, tiles, metal, marbles, sunmica). From each type of porous and non-porous study material, triplicate fingerprint samples were taken and individually labelled. Once deposited, the fingerprints on the porous and non-porous study materials were left open at room temperature (28 – 30℃) for up to 6 hours. The conventional powder dusting method was used to develop the latent fingerprints. The powder was sprinkled over the affected area, and the excess powder was removed by tapping. It is advisable to cover your face with a mask during the development procedure as inhalation of fine powder particles may trigger certain allergic reactions (such as coughing, sneezing, etc.). The fingerprints were then visualized using spathe powder, and subsequently photographed by mobile camera (Oneplus nord2) for record-keeping purposes.

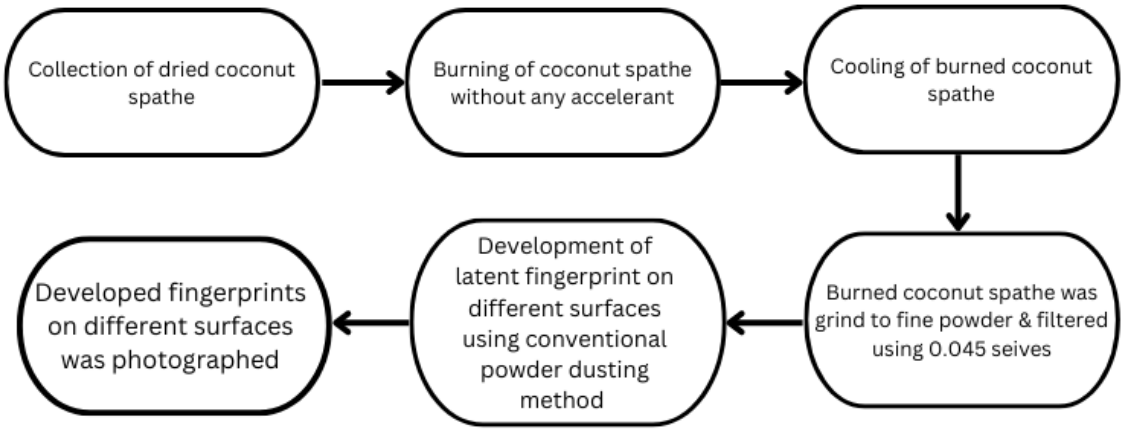

Fig. 1 Flowchart showing the process of development of powder from coconut spathe.

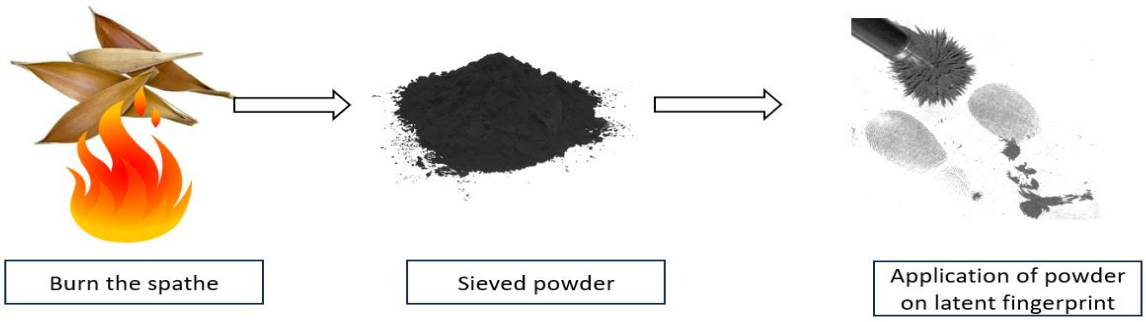

Fig. 2 Graphical illustration of the methodology employed for the current study

III. RESULTS AND DISCUSSION

The study aimed to investigate the feasibility of using newly developed Spathe powder as an alternative form of fingerprint powder, to aid in tracing the presence of latent fingerprints on probable places where the perpetrator may have left their fingerprints. The study materials used in the research were chosen to mimic the metallic and glossy surface of weapons, such as knives and glasses, and commonly found evidence at the scenes of crime. Additionally, the fingerprint samples were intentionally groomed to resemble the natural act of touching the face and/or other hairy parts of the body, such as arms.

The results of the study showed that the finely ground Spathe powder was able to visualize fingerprints on both porous and non-porous study materials, such as sunmica, glass, marble, coated metal, tiles, plastic, gypsum board, paper, and gypsum wall. The development of latent fingermarks on different substrates using Spathe powder is shown in Fig.3 of the study.

This research has significant implications for forensic investigations, as it suggests that Spathe powder could be used as an effective alternative to traditional fingerprint powder in cases where latent fingerprints are present but untraceable. By improving the ability to detect and visualize latent fingerprints, this study could ultimately aid in the identification and capture of perpetrators of crimes.

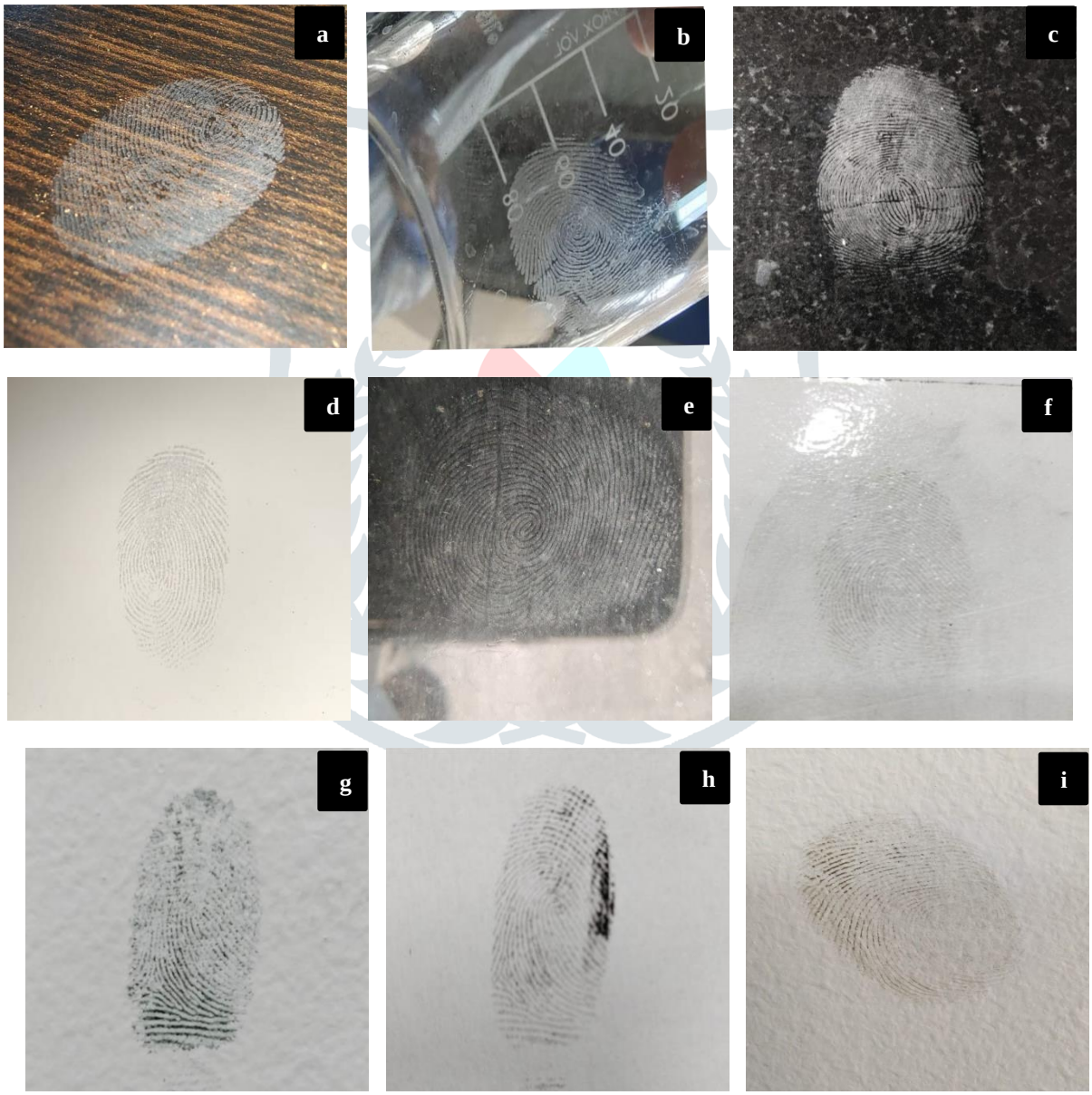

Fig 3. Developed fingerprint on porous and non-porous surfaces: a) sunmica b) glass c) marble d) metal e)floor tiles f) plastic sheet g) gypsum board h) paper i) wall

The present study demonstrates that the quality of latent fingerprints on non-porous surfaces is superior due to their lower sweat absorption as compared to porous surfaces. A greater degree of fingerprint residue absorption is observed on substrates with higher porosity. The smoothness of the substrate also plays a crucial role in determining the depth of penetration of the fingerprint residues, which has been found to be inversely proportional to the degree of smoothness. In contrast, porous substrates are capable of absorbing the components of fingerprint deposits left on them, resulting in a rapid absorption process. Fingerprint deposits on porous

surfaces are known to penetrate the surface, with the degree of penetration being influenced by environmental conditions such as relative humidity and the degree of porosity of the surface. Higher relative humidity and degree of porosity result in more extensive penetration of fingerprint deposits. On the other hand, non-porous substrates are incapable of absorbing any of the components of fingerprint deposits left on them.

The newly developed coconut spathe powder exhibits excellent fingerprint powder properties and is organic, inexpensive, and non-toxic. It adheres distinctly to the fingermark ridges and provides clear development on the majority of substrates. Although the method is simple and effective, caution must be exercised during powdering, as the marks are highly sensitive and may get smudged easily, thus becoming unusable.

IV. CONCLUSION

Police and law enforcement agencies have struggled long to find a reliable method for visualizing latent fingerprints at crime scenes. Scientists have attempted to improve existing methods, but until now there has not been a single method that could be used on all surfaces and under all conditions. In an attempt to address this issue, researchers have conducted a study on the use of coconut spathe powder to develop latent fingerprints on a broad range of surfaces with lighter backgrounds.

The study found that the majority of latent prints present on various surfaces could be successfully developed with this powder. The powder was particularly effective on opposite contrast surfaces and could be used on both non-porous and porous substrate. The optimized method described in the study is commonly available, less expensive, non-toxic, and can be used on a broad spectrum of surfaces.

While the study provides a good substitute for fingerprint visualization, there are some potential issues that may arise during the process, such as the moistening of the powder. Nevertheless, the use of everyday materials to reveal latent fingerprints is an important development in forensic science.

The study is in its preliminary stages and can be further explored with time-based factors, etc. However, it provides a promising option for law enforcement agencies to use in instances where other powders are scarce or toxic or due to high costs. The study's results were significant for intended latent fingerprints visualizations.

Acknowledgment

I would like to express my sincere gratitude to the Department of Forensic Science, Jharkhand Raksha Shakti University Ranchi, India for providing lab infrastructure that helped a lot in conducting this study. Special thanks to all teaching and non-teaching staff of JRSU for their constructive feedback and encouragement. Lastly, I extend my appreciation to the volunteers of this study for providing fingerprint samples. enabling the completion of this research.

Funding:

There is no financial assistance provided for this study.

REFERENCES

1. R. Saferstein, Forensic science: From the crime scene to the crime lab (Pearson, New Jersey, 2013) pp. 161
2. Bramble SK, Brennan JS. Chemistry of print residue. In: Siegel PJ, Saukko PJ, Knupfer GC, editors. Encyclopedia of forensic sciences. Academic Press; 2000. p. 862–9. http://dx.doi.org/ 10.1006/rwfs.2000.0737.
3. Omar Muhammad Yusof, Ellsworth Laura. Possibility of using fingerprint powders for development of old fingerprints. Sains Malays 2012;41(4):499–504.
4. Choi MJ, McDonagh AM, Maynard PJ, Wuhrer R, Lennard C, Roux C. Preparation and evaluation of metal nanopowders for the detection of fingermarks on nonporous surfaces. J Forensic Ident 2006;56(5):756–68.
5. Kumari Harish, Kaur Ramanjit, Garg Rakesh K. New visualizing agents for latent fingerprints: synthetic food and festival colors. Egypt J Forensic Sci 2011;1(3-4):133–9. http://dx.doi.org/10.1016/ j.ejfs.2011.07.006.
6. Garg RK, Kumari Harish, Kaur Ramanjit. A new technique for visualization of latent fingerprints on various substrates using powder from turmeric: a rhizomatous herbaceous plant (Curcuma longa). Egypt J Forensic Sci 2011;1:53–7. http://dx.doi.org/ 10.1016/j.ejfs.2011.04.011.
7. Singh Kulvir, Sharma Sahil, Garg Rakesh K. Visualization of latent fingerprints using silica gel G: a new technique. Egypt J Forensic Sci 2013;3(1):20–5. http://dx.doi.org/10.1016/ j.ejfs.2012.09.001.
8. Sodhi GS, Kaur J, Garg RK. Fingerprint powder formulation based on basic fuchsin dye. J Forensic Med Toxicol 2004;21(1):8–9.
9. Sodhi GS, Kaur J. A novel, cost effective organic fingerprint powder based on fluorescent eosin yellow dye. Indian J Criminol 1999;27(3–4):73–4.
10. Sodhi GS, Kaur J. Novel, cost effective organic fingerprint powder based on phloxine B dye. Def Sci J 2000;50(2):213–5.
11. Sodhi GS, Kaur J, Garg RK. A fingerprint powder formulation based on rhodamine B. J Forensic Ident 2003;53(5):551–5.

12. Graham D. Some technical aspects of demonstration and visualization of fingerprints on human skin. J Forensic Sci 1969;14(1):1–12.
13. Goode GC, Morris JR, Pierre Margot, Milutin Stoilovic. A review of their origin, composition and methods of detection. Aldermaston: AWRE; 1983 report no. O 22/83. 16. Bridges BC. Practical fingerprinting. New York: Funk and Wagnalls Company Inc.; 1963.
14. Kerr FM, Haque F, Barson IW. Organic based powders for latent fingerprint detection on smooth surfaces. Part I. Can Soc Forensic Sci Int 1983;16:39–44.
15. Gabay Almog J. Chemical reagents for the development of latent fingerprints. III. Visualization of latent fingerprints by fluorescent reagents in vapor phase. J Forensic Sci 1980;25(2):408–10.
16. Howard S. Basic fuchsin–a guide to one step processing for black electrical tape. J Forensic Sci 1993;38(6):1391–403.
17. Almog J, Cohen Y, Azoury M, Hahn TR. Genipin- a novel fingerprint reagent with calorimetric and fluorogenic activity. J Foren Sci. 2005;50:1367–1371.
18. Mopoung S, Thongcharoen P. Coloured intensity enhancement of latent fingerprint powder obtained from banana peel activated carbon with methylene blue. Sci Res Essay. 2009;4:008–012.
19. Garg RK, Kumari H, Kaur R. A new technique for visualization of latent fingerprints on various surfaces using powder from turmeric: a rhizomatous herbaceous plant (Curcuma longa). Egypt J Foren Sci. 2011;1:53–57.
20. Low WZ, Khoo BE, Aziz ZBA, Low LW, Teng TT, Abdullah AFL. Application of acid modified Imperata cylinderica powder for latent fingerprint development. Sci Justice. 2015;55:347–354