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Development Of Latent Fingerprint By Using Drumstick Skin Powder

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Abstract : A fingerprint is impression made by the frictional ridges of the fingers on various surface such as porous, nonporous and semi porous. Being one of the useful and robust forensic evidence fingerprints have been widely recognized as the primary human identification tool in forensic investigation. Latent or invisible prints are commonly found at the scenes of crime and thus require the use of visualization methods. The currently available fingerprint visualization powdered methods are chemical with toxic and potential health hazards are. This study proposes a cheap and relatively fingerprint powder from drumstick skins. The findings revealed that drumstick skin powder is capable of visualizing latent fingerprint on porous, non-porous and semi porous surfaces. The latent fingerprints enhanced by drumstick skin powder showed better visualization. It is a non-toxic, safe and easily available powder.

Key Words: **Fingerprint, Latent print, Invisible print, Frictional ridges, Fingerprint powders.**

I. INTRODUCTION

FINGER PRINT

Fingerprint examination is a significant branch of forensic science due to fingerprints being unique and permanent (Vadivel & Nirmala, 2020). Latent prints are not visible prints deposited on a surface by the natural secretions of friction ridge skin (Badiye & Kapoor, 2015). Developing latent fingerprints means employing chemical, physical, or optical methods to render these prints visible. The conventional fingerprint development techniques like powder dusting, cyanoacrylate fuming, and chemical treatment have been extensively practiced, but they include dangerous chemicals and costly equipment (De Alcaraz-Fossoul et al., 2012). With the development of forensic science, there is a growing necessity to create cost-efficient, non-toxic, and eco-friendly methods for fingerprint visualization.

Drumstick (Moringa oleifera) is a medicinal and nutritionally rich plant. The outer skin of the plant possesses bioactive substances with adhesive and coloring characteristics, thus making it a promising natural material for fingerprint development (Rohatgi & Kapoor, 2014). Natural products have been researched as substitutes for conventional chemical-based fingerprint development methods in recent years due to their non-toxic and environmentally friendly characteristics (Eskalen et al., 2020). Utilizing drumstick skin for latent fingerprint development aligns with forensic needs for cost-effective, sustainable, and accessible methods, particularly in resource-limited settings (Darshan et al., 2025).

Fingerprint evidence is the most trustworthy form of personal identification to be used in forensic analysis (Vadivel & Nirmala, 2020). The development of latent fingerprints is significant for the resolution of criminal cases since fingerprints are able to connect a suspect with a crime scene (Badiye & Kapoor, 2015). Conventional fingerprint development methods are effective but also have a number of challenges. Chemical-based reagents and powders tend to include harmful chemicals that can potentially endanger the health of forensic investigators (Chauhan & Chattopadhyay, 2014). These techniques can also be costly and need specific apparatus, thus limiting their use in low-resource forensic labs (Fouda-Mbanga et al., 2023).

Recent forensic studies have examined different natural materials for fingerprint development. One study examined plant extracts and powders and proved their efficacy in the development of latent prints (De Alcaraz-Fossoul et al., 2012). Another review pointed out that most plant extracts interact with fingerprint residues, making prints more visible (Badiye & Kapoor, 2015). Similarly, studies on the powders of turmeric, beetroot, and henna have also given promising outcomes in fingerprint development (Dhunna et al., 2018). An investigation on the chemical constitution of Moringa oleifera has discovered its antioxidant property and bioactive substances, which can make it a potential choice for fingerprint development (Godara et al., 2022). Nevertheless, even with these breakthroughs, targeted research on drumstick skin for fingerprint development is limited.

Research Gaps and Justification

Whereas many research studies have analyzed the natural fingerprinting creation methods, a few still remain to be closed:

• Most of the research involved common plants like turmeric and henna, with little research on Moringa oleifera.

• The effectiveness of plant extracts in various environmental conditions and on various surfaces still remains to be widely researched.

• A comparison with plant-based techniques to conventional fingerprint developing techniques is missing in most studies. (da Rosa et al., 2022)

This research will close these gaps and investigate a new, green latent fingerprint development process based on drumstick skin. Moringa oleifera is readily available and cheap and thus presents a viable alternative to chemical reagents for fingerprint development. Moreover, as forensic science shifts towards green methodologies, there is a need to investigate plant-based substances that are non-toxic and efficient.

II. LITERATURE REVIEW

1. **Josep De Alcaraz-Fossoul et al. (2012)** studied ***"Determination of Latent Fingerprint Degradation Patterns—A Real Fieldwork Study"*** aimed to analyze how latent fingerprints degrade over time under different environmental conditions. This study highlighted that fingerprints, despite being crucial forensic evidence, deteriorate at different rates depending on factors such as temperature, humidity, air currents, and exposure to light. The researchers used titanium dioxide-based powder as a fingerprint developer and examined latent prints on glass and plastic surfaces over a period of six months. Results indicated that sebaceous prints on glass surfaces remained identifiable for longer periods, whereas prints on plastic degraded at a much faster rate, especially when exposed to sunlight and fluctuating environmental conditions. The study emphasized the challenges of estimating fingerprint age but provided insights into how different storage conditions impact fingerprint longevity.[3]
2. **Chauhan Amit and Chattopadhyay P.K. (2014)** studied ***"Development of Latent Dermal Ridges Present on Fruits and Vegetables"*** explored the effectiveness of different fingerprint development techniques on unconventional surfaces like fruits and vegetables. The study emphasized that latent fingerprints, which are often fragile, can also be recovered from food surfaces found at crime scenes. Various fruits and vegetables, including banana, eggs, tomato, potato, and capsicum, were used as substrates, and different fingerprint development methods such as black powder, silver gray powder, orange fluorescent powder, and iodine fuming were applied. The results demonstrated that fluorescent powder provided the best contrast and visibility on most surfaces, while black powder worked effectively on eggs and potatoes. The study concluded that fingerprints on food items can serve as valuable forensic evidence, aiding in suspect identification.[4]
3. **Richa Rohatgi and A.K. Kapoor (2014)** studied ***"New Visualizing Agents for Developing Latent Fingerprints on Various Porous and Non-Porous Surfaces Using Different Household Food Items"*** explored the effectiveness of common household food powders as an alternative to conventional fingerprint development powders. The study emphasized that traditional fingerprint powders often contain toxic chemicals that pose health risks. In this research, food-based powders such as cocoa powder, turmeric, custard powder, corn flour, baking soda, and black salt were tested

on various porous (paper, currency note, fruit peel) and non-porous (glass, plastic, steel, ceramic tile) surfaces. Results showed that cocoa powder, turmeric, and baking soda provided the best fingerprint development, producing clear ridge patterns on both porous and non-porous surfaces. The study concluded that household food powders offer a cost-effective, non-toxic, and easily available alternative for forensic fingerprint development, especially in cases of limited access to commercial powders.[7]

4. **Ashish Badiye and Neeti Kapoor (2015)** studied ***"Efficacy of Robin® Powder Blue for Latent Fingerprint Development on Various Surfaces"*** examined the effectiveness of Robin® powder blue, a common household fabric whitening agent, in developing latent fingerprints. The study highlighted that latent fingerprints are fragile and prone to damage. Among the various methods used for fingerprint development, powder dusting is the simplest and fastest technique. In this research, Robin® powder blue was tested as a cost-effective, non-toxic, and readily available alternative to commercial fingerprint powders. The study evaluated its efficiency on 24 different surfaces, considering their frequent occurrence in crime scenes. The results demonstrated that Robin® powder blue provided excellent fingerprint development, even on complex and multicolored surfaces, making it a promising forensic tool.[2]
5. **L. Alem et al. (2017)** studied ***"Efficiency of DNA Recovery from Fingerprints Enhanced with Black and Magnetic Powders"*** analyzed the possibility of obtaining genetic profiles from fingerprints developed using forensic powders. This study highlighted that fingerprints are fragile, and even after successful enhancement, identification may fail. In such cases, DNA analysis can be an alternative approach. The researchers tested black and magnetic fingerprint powders on glass surfaces to evaluate their impact on DNA recovery. Their findings revealed that while magnetic powder resulted in higher DNA yields, the black powder provided better STR (Short Tandem Repeat) analysis, recovering 66% of alleles compared to 35% for magnetic powder. The study concluded that black powder is a preferable choice for fingerprint enhancement when DNA analysis is required for forensic investigations.[16]
6. **Mahendran Sekar and Nur Fatin Zulkifli (2017)** studied ***"Development of Natural Latent Fingerprint Powder from Durian Seeds – A Green and Effective Approach in Crime Scene"*** explored the use of durian seed powder as an eco-friendly alternative for fingerprint development. Traditional fingerprint powders often contain toxic chemicals, posing health hazards to forensic professionals. This study aimed to overcome these issues by utilizing durian seeds, which are rich in starch, to develop a natural latent fingerprint powder. The researchers tested the powder on various porous and non-porous surfaces, including aluminum sheets, CDs, plastic bottles, and glass. The findings revealed that durian seed powder effectively adhered to latent fingerprints, particularly on dark-colored surfaces, due to the formation of hydrogen bonds between the fatty acids in fingerprint residue and the starch components of the powder. However, the study noted that durian seed powder was less effective on white surfaces due to low contrast. The research concluded that durian seed

powder is a cost-effective, non-toxic, and sustainable alternative to conventional fingerprint powders, with promising applications in forensic investigations.[15]

7. **V. Ramanan and M. Nirmala (2020)** studied ***"Visualization of Latent Fingerprints Using Neutral Alumina as an Inexpensive Fingerprint Developing Powder"*** explored the efficiency of neutral alumina powder in developing latent fingerprints. The study emphasized that fingerprint development is crucial in forensic investigations, but many traditional powders are expensive, toxic, and difficult to access. In this research, neutral alumina—commonly used in thin-layer chromatography—was tested as a cost-effective and non-toxic alternative. The powder was examined on sixteen different surfaces, including porous and non-porous materials. The findings revealed that neutral alumina provided excellent contrast and visibility on most surfaces, making it an efficient substitute for commercial fingerprint powders. Furthermore, confocal laser scanning microscopy analysis demonstrated that fingerprints developed with neutral alumina could reveal Level 2 and Level 3 fingerprint details, such as minutiae points and sweat pores, enhancing forensic examination capabilities.[1]
8. **Hasan Eskalen et al. (2020)** studied ***"Green Synthesis of Water-Soluble Fluorescent Carbon Dots from Rosemary Leaves:*** *Applications in Food Storage Capacity, Fingerprint Detection, and Antibacterial Activity"* examined the potential of fluorescent carbon dots synthesized from rosemary leaves for fingerprint detection. The study highlighted that latent fingerprints are fragile and require effective enhancement techniques. The researchers developed polyvinyl alcohol (PVA)-carbon dot composites and tested them on glass surfaces under UV light exposure. The results demonstrated that fingerprints were successfully visualized using carbon dot coatings, whereas PVA alone did not provide visibility. This study concluded that carbon dot composites offer a sustainable, cost-effective, and non-toxic alternative for forensic fingerprint development, along with potential applications in food preservation and antibacterial treatments.[6]
9. **Harshita Niranjan et al. (2022)** studied ***"Unconventional Powder Method is a Useful Technique to Determine the Latent Fingerprint Impressions"*** explored the effectiveness of non-conventional powders for developing latent fingerprints. This study emphasized that traditional fingerprint powders often contain toxic chemicals and are expensive, necessitating the need for safer and cost-effective alternatives. In this research, common household powders such as turmeric, talcum, vermillion, and Fuller's earth were tested on porous, non-porous, and semi-porous surfaces. The results demonstrated that turmeric powder provided visible fingerprints on plastic sheets, vermillion powder worked best on steel surfaces, and Fuller's earth produced clear prints on glass. The study concluded that unconventional powders are non-toxic, inexpensive, and readily available alternatives that can be effectively used for forensic fingerprint development.[17]
10. **Bruno Nunes da Rosa et al. (2022)** studied ***"Green Composites from Thiophene Chalcones and Rice Husk Lignin: An Alternative of Powder for Latent Fingermark"*** explored the development of an eco-friendly fingerprint powder using rice husk lignin and thiophene chalcones. The study emphasized that conventional fingerprint powders often contain toxic and non-biodegradable

components, making them less sustainable. In this research, the green composite was synthesized and tested on glass, cardboard, and ceramic surfaces. The results demonstrated that the composite provided high-contrast fingerprint visualization with minimal background staining, revealing clear ridge details. The study concluded that this sustainable and cost-effective composite serves as a promising alternative for latent fingerprint development in forensic investigations.[11]

11. **Vanisha Godara et al. (2022)** studied ***"Comparative Study of Rose and Hibiscus Petals Powders in Latent Friction Ridge Analysis"*** explored the effectiveness of rose and hibiscus petal powders as eco-friendly alternatives for latent fingerprint development. This study emphasized that conventional fingerprint powders often contain toxic chemicals that may pose health risks. The researchers tested rose and hibiscus petal powders on various porous and non-porous surfaces, including glass, plastic, steel, marble, and aluminum foil. The results demonstrated that rose petal powder provided higher ridge clarity on most surfaces, whereas hibiscus petal powder performed well on surfaces with contrasting backgrounds. The study concluded that organic powders derived from household waste materials offer a cost-effective, non-toxic, and environmentally friendly alternative for forensic fingerprint development.[13]
12. **Bienvenu-Gael Fouda-Mbanga et al. (2023)** studied ***"Novel Development of Zinc Oxide–Coated Carbon Nanoparticles from Pineapple Leaves Using Sol-Gel Method for Optimal Adsorption of Cu^{2+} and Reuse in Latent Fingerprint Application"*** explored the synthesis of zinc oxide-coated carbon nanoparticles (N-CNPs/ZnONPs) for both environmental and forensic applications. This study emphasized that traditional fingerprint powders can be toxic and expensive, necessitating the need for eco-friendly alternatives. The researchers developed N-CNPs/ZnONPs from pineapple leaf powder and tested them for latent fingerprint visualization on porous surfaces. The results demonstrated that Cu^{2+}-loaded N-CNPs/ZnONPs showed high sensitivity and selectivity for fingerprint detection, producing clear ridge details. The study concluded that this nanocomposite is an effective, sustainable, and multi-functional tool for forensic fingerprint enhancement.[8]
13. **Abhishek Rai et al. (2024)** studied ***"Low-Cost Alternative Approach to Developing Latent Fingerprints Using Roasted Gram Flour (Sattu Powder)"*** explored the effectiveness of roasted gram flour as a natural and eco-friendly fingerprint development powder. This study emphasized that conventional fingerprint powders can be toxic and expensive, creating a need for non-toxic, affordable, and accessible alternatives. The researchers tested sattu powder on 12 different surfaces, including glass, plastic, steel, rubber, plywood, and marble, to develop sebaceous, eccrine, and natural fingerprints. The results demonstrated that sattu powder provided high-quality ridge details on glass, plastic, and steel surfaces, with clarity scores ranging from 80-100%. The study concluded that sattu powder is a low-cost, safe, and effective alternative for forensic fingerprint development, particularly in resource-limited settings.[10]
14. **Vaibhav Sharma et al. (2024)** studied ***"Exploring the Potential of Syzygium cumini (L.) Skeels (Jamun) Seed Powder as an Eco-Friendly Agent for Developing Friction Ridges on Porous and Nonporous Surfaces"*** investigated the efficiency of jamun seed powder as an alternative latent

fingerprint development agent. This study emphasized that traditional fingerprint powders often contain toxic chemicals that may pose environmental and health risks. The researchers tested jamun seed powder on a variety of porous and nonporous surfaces, including glass, plywood, ceramic tiles, iron, and plastic. The findings demonstrated that jamun seed powder provided clear and detailed fingerprint impressions with high ridge clarity, making it an effective and environmentally friendly alternative. The study concluded that jamun seed powder is a cost-effective and sustainable option for forensic fingerprint development.[12]

III. AIM AND OBJECTIVES

AIM:

To develop latent finger print using Drumstick skins.

OBJECTIVES:

1. To develop the latent fingerprint by using drumstick skin powder.
2. To develop a cost effective, simple fingerprint powder.
3. To develop a latent fingerprint powder which is non-toxin in nature.
4. To develop latent fingerprint, present in various surfaces.

IV. MATERIALS AND METHODOLOGY

MATERIALS:

1. Drumstick
2. Boiling water
3. Drumstick skin (outer layer)
4. Cloth
5. Knife
6. Spoon
7. Mixer
8. Sieve (fine mesh)
9. Airtight container
10. Fine brush

Fig:1&2 (Drumstick& Boiling water)

Fig:3&4 (Drumstick skin &Cloth)

Fig:5 (Knife)

Fig:6 (Spoon)

Fig:7 (Mixer)

Fig:8 (Sieve)

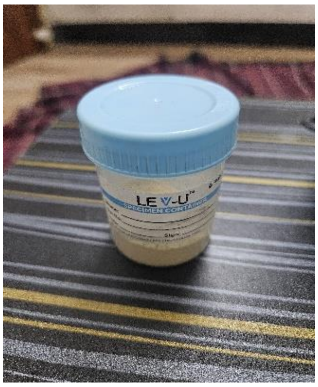

Fig:9 (Airtight container)

Fig:10 (Fine brush)

METHODOLOGY:

PREPARING DRUMSTICK SKIN POWDER:

1. Collection and preparation:

Get a fresh drumstick.

Cut the drumstick into small pieces.

2. Boiling: Boil the drumstick in water for 30 minutes (depending on thickness). It helps in impurities removing and skin softening.

3. After boiling, use a spoon or knife to remove in the inner pulp.

4. To dry, place the skins on a clean cloth and allow them to dry in direct sunlight for 2-3 days.

When pressed, be sure that they are easily breakable and completely dry.

5. Grinding:

Once fully dried, grind the skins using a mixer/grinder until a fine powder forms.

6. Sieving:

Pass the powder through a fine sieve (2–3 times) to ensure uniform particle size.

Collect the finest powder for fingerprint development.

7. Storage:

Store the prepared powder in an airtight container to prevent moisture absorption.

DEVELPOMENT OF LATENT FINGER PRINT:

*The external surface with the latent finger print is selected. The drumstick skin powder is taken in a container, with the help of a brush.

*Then the powder is smeared over the finger print. It is applied in a gentle swirling motion.

*once the print is developed, it is lifter using finger print lifting tape.

* After lifting it is photographed.

V. FINGERPRINT SAMPLES ON VARIOUS SURFACES

Fig:1 Helmet

Fig:2 Phone screen

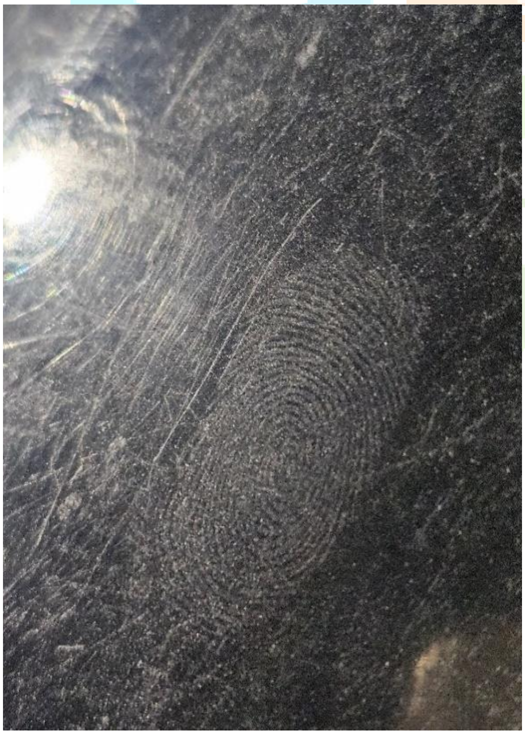

Fig:3 Mixer

Fig:4 Looking mirror

Fig:5 Refrigerator

Fig:6 Steel bench

Fig:7 Card board

Fig:8 Polishing wooden door

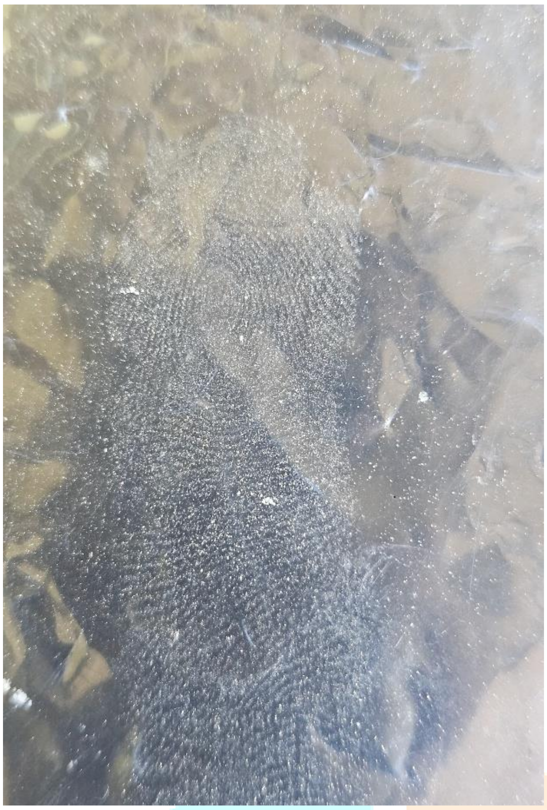

Fig:9 File

Fig:10 Mobile case

Fig:11 Mixer jar

Fig:12 Passport size photo

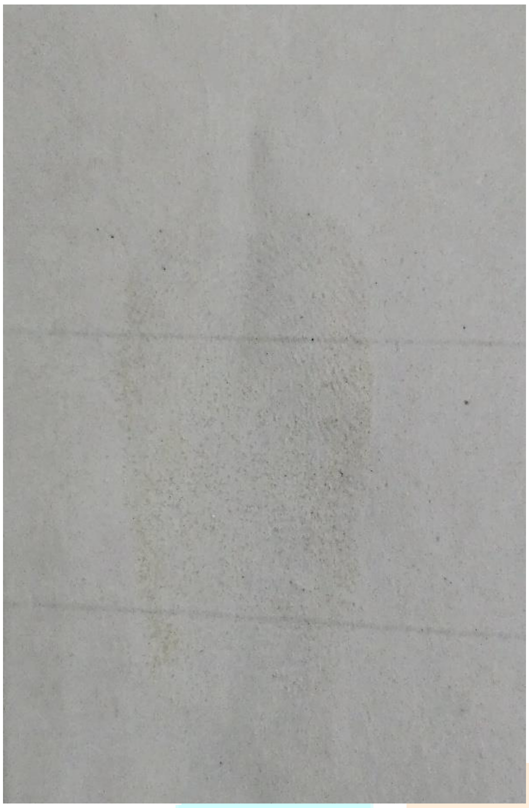

Fig:13 Paper

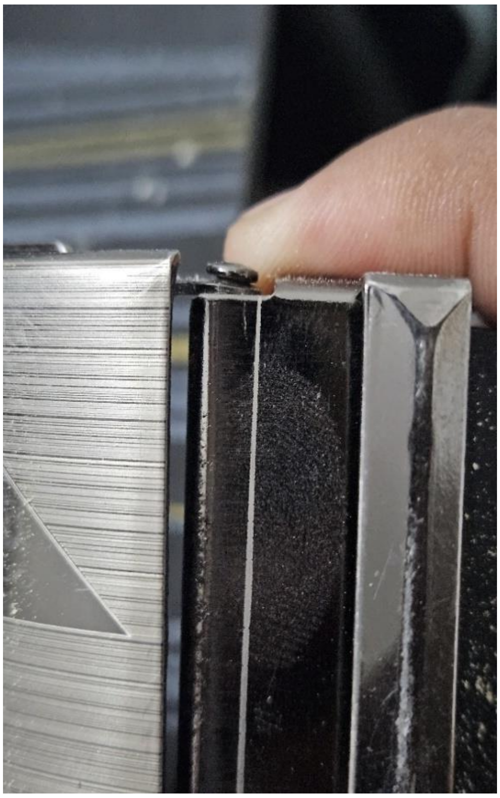

Fig:14 Belt

Fig:15 Belt leather

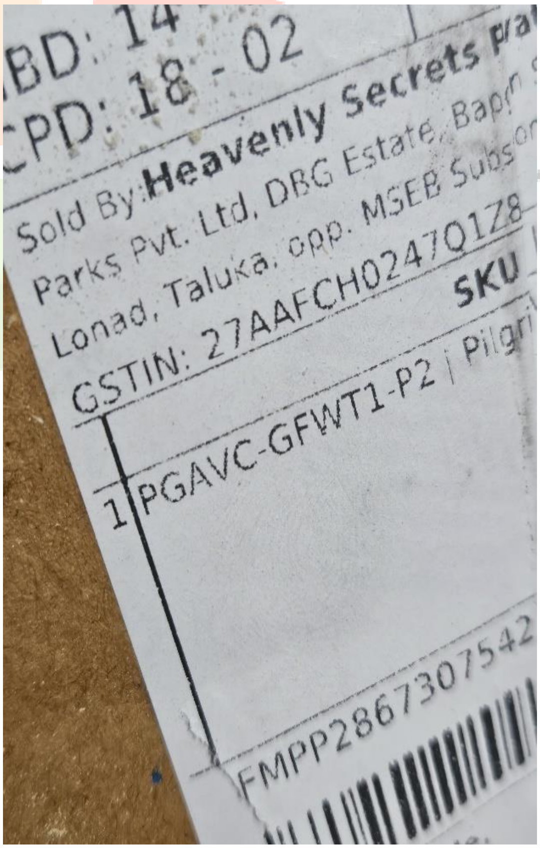

Fig:16 Parcel box paper

Fig:17 Syrup bottle

Fig:18 Plastic door

Fig:19 Transparent plastic sheet

Fig:20 Plastic coated paper roll

VI. DISCUSSION

S.NO	Sample & surface	FULLY DEVELOPED	PARTIALLY DEVELOPED
1.	Latent print on helmet (Non-porous)	✓	
2.	Latent print on phone screen (Non- porous)	✓	
3.	Latent print on mixer (Non-porous)	✓	
4.	Latent print on looking mirror (Non-porous)	✓	
5.	Latent print on refrigerator (Non-porous)	✓	
6.	Latent print on steel bench (Non-Porous)	✓	
7.	Latent print on card board (Semi Porous)		✓
8.	Latent print on wooden door polishing surface (Non-porous)		✓
9.	Latent print on file (Non-porous)		✓
10.	Latent print on mobile case (Non-porous)		✓
11.	Latent print on mixer jar (Non-porous)	✓	

12.	Latent print on passport size photo (Porous)	✔	
13.	Latent print on paper (porous)		✔
14.	Latent print on belt (Non-porous)		✔
15.	Latent print on belt leather (Semi-porous)	✔	
16.	Latent print on parcel box paper (Semi-porous)		✔
17.	Latent print on syrup bottle (Non-porous)	✔	
18.	Latent print on plastic door (Non-porous)		✔
19.	Latent print on transparent plastic sheet (Non-porous)	✔	
20.	Latent print on plastic coated paper roll (Semi-porous)		✔

The results indicate that drumstick skin powder is an effective fingerprint-developing agent on non-porous and some semi-porous surfaces. The high success rate on surfaces like mirrors, phone screens, and steel benches highlights the potential of this powder as a viable alternative to commercial fingerprint powders. The partially developed fingerprints suggest that certain porous and semi-porous surfaces may require modifications in powder composition, application technique, or additional treatment.

Drumstick skin powder is an eco-friendly and cost-effective alternative to conventional fingerprint powders. The natural composition ensures that it is non-toxic, making it safer for forensic professionals and reducing environmental impact.

VII. RESULT AND CONCLUSION

The present study focused on the development of latent fingerprints using drumstick skin powder as an alternative fingerprint powder. The objective was to assess the effectiveness, cost-efficiency, non-toxic nature, and applicability of this powder on various porous, semi-porous, and non-porous surfaces. The developed drumstick skin powder exhibited good adherence to the fingerprint residues, revealing clear ridge patterns. The powder was successfully applied to a variety of surfaces, with results categorized into fully developed and partially developed fingerprints.

Results on Different Surfaces

A total of 20 surfaces were tested for fingerprint development using drumstick skin powder. Out of these, 11 surfaces showed fully developed fingerprints, while 9 surfaces exhibited partial development. The summary of findings is presented below:

Fully Developed Fingerprints (11 Surfaces)

1. Helmet (Non-porous)
2. Phone screen (Non-porous)
3. Mixer (Non-porous)
4. Looking mirror (Non-porous)
5. Refrigerator (Non-porous)
6. Steel bench (Non-porous)
7. Mixer jar (Non-porous)
8. Passport size photo (Porous)
9. Belt leather (Semi-porous)
10. Syrup bottle (Non-porous)
11. Transparent plastic sheet (Non-porous)

These surfaces displayed distinct ridge patterns with high visibility, making the drumstick skin powder an effective agent for fingerprint development on these materials.

Partially Developed Fingerprints (9 Surfaces)

1. Cardboard (Semi-porous)
2. Wooden door with polishing surface (Non-porous)
3. File (Non-porous)
4. Mobile case (Non-porous)
5. Paper (Porous)
6. Belt (Non-porous)
7. Parcel box paper (Semi-porous)
8. Plastic door (Non-porous)
9. Plastic-coated paper roll (Semi-porous)

These surfaces showed incomplete ridge development, suggesting that the powder's adhesion varied based on surface texture and porosity.

CONCLUSION

The study successfully demonstrated that drumstick skin powder can be used for latent fingerprint development. While it provided clear results on 11 surfaces, further optimization is needed for its efficacy on semi-porous and porous materials. This research opens avenues for sustainable forensic practices using biodegradable materials.

VIII. LIMITATIONS

Despite its effectiveness, this study has certain limitations:

1. Environmental and Storage Factors - Humidity and temperature may affect the consistency and effectiveness of the powder, necessitating controlled storage conditions.
2. Durability of Developed Prints - The developed fingerprints may fade over time, limiting their usability in long-term forensic analysis.
3. Comparative Analysis with Commercial Powders - The performance of drumstick skin powder was not extensively compared with commercially available powders, leaving room for further comparative studies.

4. Powder Preparation Standardization - The preparation process may need further refinement to ensure uniform particle size and consistent application.
5. Surface Dependency - The effectiveness varies significantly across different surfaces, requiring further optimization for wider applicability.
6. Less Visibility on Light Colored Surfaces - The drumstick skin powder is light sandal in color, making fingerprint visibility lower on light colored surfaces.

IX. FUTURE RECOMMENDATIONS

1. To examine his powder on the surfaces which are in extreme heat and cold conditions.
2. Doing further study in more surfaces to determine the effective development.
3. Investigating ideal storage methods to maintain powder effectiveness over time.
4. Refining the preparation process to achieve consistent particle size and uniform application.
5. Developing dyes or additives to improve visibility on light-colored surfaces.

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