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Research Article

# Comparative Evaluation of Plant-Derived Ash Powders for the Development of Latent Fingerprints on Different Surface Types

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**ABSTRACT:**

The distinctive arrangement of ridges and valleys on the surface of a person's fingertip is known as a fingerprint. After creation, the ridge pattern stays the same; they remain same throughout life. A fingerprint is an individual trait of a person. A latent fingerprint is developed with the help of physical and chemical methods. In this paper, we are using physical methods: In physical methods, we can use different types of powders to decipher the latent fingerprint. Here we are using the leaf ash powder method. This powder is successful in visualizing the ridge patterns of fingerprints on porous surfaces such as cardboard and wooden surfaces, as well as non-porous surfaces including stainless steel, glass, ceramic tile, windows, marble, electronic gadgets (mobile phone, laptop, charger, etc.), water bottles, and cover paper (Example – notebook cover). Scientific Name – Eucalyptus Globulus, Kingdom – Plantae, Order – Myrtales, Family – Myrtaceae, Genus – Eucalyptus. Leaf ash powder is derived from Natural sources (burned plant leaves) make it a sustainable and non-toxic alternative to commercial fingerprint powder. Leaf ash powder primarily works on physical adherence. Leaf ash powder is composed of fine carbon-based particles and mineral residue. Ash powder is applied to the desired surface; the fine particles adhere to moisture, oil, and organic residue present in the fingerprint ridges due to van der Waals forces and electrostatic interactions. The adhered powder outlines the ridge patterns, making the latent fingerprint visible. "The use of leaf ash powder enabled the clear development of latent fingerprints on a variety of surfaces. The ridge characteristics is visible distinct and well-defined, with limited alteration from the background. The technique showed consistent performance on both permeable and non-permeable materials, including glass, paper, and metal surfaces. It can be concluded that leaf ash serves as a simple and environmentally safe option for developing latent fingerprints. Due to its affordable, environmentally safe, and easy preparation, it can be effectively used as an alternative to conventional powders, particularly in situations where resources are limited." As an easy to use & eco-friendly, leaf ash offers substantia value, especially in resource limited environment. Further research into different types of leaf ash and their specific properties could enhance the stability and performance of this method in operational forensic investigations.

**Keywords:** Fingerprint, Eucalyptus Globulus,Leaf ash powder, Porous,Non porous.

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## INTRODUCTION

Fingerprints are formed when the fingers touch different types of surfaces such as porous, semi-porous, or non-porous materials. The impressions left behind are mainly due to sweat secretions from the skin. This sweat contains a mixture of substances including fatty acids, urea, water, and organic compounds such as amino acids, glucose, lactic acid, peptides, ammonia, and riboflavin. It also includes inorganic components like potassium, sodium, carbon dioxide, and chlorine. These substances get deposited on surfaces and create visible or latent impressions. The amount and nature of these deposits can vary depending on several factors such as the type of activity involved, environmental conditions, and the physical characteristics of the individual. Since fingerprints originate directly from the human body, they are unique to each person and play a crucial role in personal identification and forensic investigations. Fingerprints are formed when the fingers touch different types of surfaces such as porous, semi-

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porous, or non-porous materials. The impressions left behind are mainly due to sweat secretions from the skin. This sweat contains a mixture of substances including fatty acids, urea, water, and organic compounds such as amino acids, glucose, lactic acid, peptides, ammonia, and riboflavin. It also includes inorganic components like potassium, sodium, carbon dioxide, and chlorine.

These compounds get place on surfaces and create visible or latent prints. The amount and nature of these store can vary on several factors such as the type of activity involved, environmental conditions, and the physical characteristics of the individual. They are unique to each person and play a crucial role in personal identification and forensic investigations. Fingerprints are the impressions formed by the friction ridge patterns located on the distal phalanges (terminal segments) of the fingers when they come into contact with a surface Friction skin refers to the specialized skin found on the inner surfaces of the hands, fingers, palms, soles, and toes. This type of skin enhances grip by increasing friction. Development of friction skin begins during approximately the third month of fatal growth. Human skin consists primarily of two layers: the epidermis and the dermis. The epidermis is the outer, thinner layer that provides protective functions. The surface of friction skin exhibits a pattern of alternating raised and depressed lines. The lifted part is known as ridges, while the grooves or depressions between them are known as furrows.

**Fingerprint Patterns:**

Fingerprint prints are classified into distinct categories based on ridge and features such as core and delta. The primary categories include loops, whorls, arches, and composite patterns. These classifications are collectively referred to as fingerprint patterns.

- An arch pattern is characterized by ridges entering from one side of the finger, rising in the centre, and exiting from the opposite side without forming a circular loop or possessing a true delta. Types Plain Arch, Tented Arch.
- loop pattern consists of ridges that enter from one side of the finger, recurve, and exit from the same side, typically containing one core and one delta. Types Ulnar Loop, Radial Loop.
- A whorl pattern is identified by circular or spiral ridge formations, generally having at least one core and two deltas.
- A composite pattern is formed by a combination of two or more different ridge patterns within a single fingerprint, exhibiting complex and irregular structures. Types Central pocket loop, Lateral Pocket Loop, Twinned Loop, Accidental.

**Types of Fingerprints at a Crime Scene:**

Fingerprints recovered from a crime scene are generally classified into three main categories based on their visibility and mode of formation.

**1. Visible (Patent) Prints**

Visible or patent prints are those that can be visible by necked eye without use any physical or chemical techniques. These impressions are formed when fingers come into contact with such as blood, ink, paint, grease, or dust. They can be documented immediately through photography, videography without requiring further development.

**2. Plastic Prints**

Plastic prints are 3D print when friction ridge is pressed against a soft or semi-solid surface. They generate negative indentation of the ridge characteristic. Such prints are commonly found on materials like softened wax, wet paint, soap, clay, or surfaces covered with a fine layer of dust. These impressions are typically preserved by direct photography or videography.

**3. Latent Fingerprints**

Latent fingerprints are not visible by necked eye and require development for visualization. They are formed by the transfer of natural secretions from the skin, including sweat and sebaceous substances, onto a surface. These prints are usually deposited on smooth or porous materials and appear faint or invisible under normal lighting conditions. For development of prints we can used different specialized techniques such as powder dusting, chemical reagents, or alternate light sources.

## MATERIAL AND METHODOLOGY

Dry leaves of Eucalyptus Globulus were collected and required for the preparation of leaf ash powder. Used on different surfaces, including glass, stainless steel, cardboard, and electronic devices such as mobile phones and laptops, where fingerprint is present. A fingerprint brush was used for powder application. A burner was used for burn

the leaf for prepare ash, and a mortar and pestle were used to obtain a fine powder. A digital camera was used for recording the developed fingerprints.

**Preparation of Leaf Ash Powder:**

To collected leaves first allowed to air-dry at room temperature. The dried leaves were then burned under controlled conditions to obtain ash. The ash was finely grind using a mortar and pestle to achieve a perfectly fine textured powder. It was then sieved to remove larger particles and stored in an airtight container until use.



Dry Leaf



Partially Burn Leaf



Ash Powder

**Fingerprint Deposition:** Latent fingerprints deposited by gently pressing fingers onto the surfaces under normal conditions. To ensure that the fingerprints not smudged and remained intact.

**Development of Latent Fingerprints**

The prepared leaf ash powder was gently applied over the surfaces with the help of fingerprint brush. Remove excess powder carefully by brush, allowing the ridge patterns to become visible. The powder adhered to the fingerprint residues due to interactions with moisture and oily secretions present on the skin.

**Documentation and Analysis**

After development of fingerprints take photographed using a digital camera. The quality of the fingerprints was assessed based on clarity, contrast, and visibility of ridge details across different types of surfaces.



Non-Porous Surface
(Mirror)



Porous Surface
(Book)

| | |
|---|---|
|  |  |
| Non-Porous Surface (Mobile Phone) | Porous Surface (Switch) |

## RESULT

The results of this study were that leaf ash powder is successful to developing latent fingerprints on different surfaces. evident and well-defined ridge patterns were observed on non-porous surfaces such as glass, stainless steel, and ceramic tiles. On semi-porous surfaces, the clarity was moderate, whereas on highly porous materials like cardboard, the visibility of fingerprints was comparatively reduced.

The efficiency of the powder can be ascribed to the fine carbon particles present in the ash, which adhere to the matter and oily residues in the fingerprint ridges. This adhesion enhances the contrast between ridges and the background, making the patterns visible.

When compared to conventional fingerprint powders, leaf ash powder showed comparable performance on non-porous surfaces. Additionally, it has advantages such as low cost, easy availability, and environmental safety. However, its performance may be limited on porous surfaces due to absorption of fingerprint residues.

## CONCLUSION

The study concludes that leaf ash powder derived from Eucalyptus Globulus can be effectively used for the development of latent fingerprints, particularly on non-porous surfaces. It serves as a cost-effective and eco-friendly alternative to conventional fingerprint powders. Further research may help improve its applicability on porous surfaces and enhance its overall efficiency.

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