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Peels to Prints- (Exploring Natural Peels for Development of Latent Fingerprints) – A Review

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Abstract:

Fingerprints are an essential piece of evidence that are used to establish identities in criminal investigations. It is now essential to find and improve these fingerprints. The techniques for creating latent fingerprints have changed over the last century, incorporating both chemical and physical processes. Because of this, fingerprint investigation techniques are constantly evolving, necessitating extensive training and practice for individuals involved in laboratory and crime scene processing to guarantee their efficacy and safety. Graphical ridge and valley patterns can be used to represent fingerprints. In the 2000s, fingerprints became the most commonly used biometric identifier due to their permanence and uniqueness. Consequently, the most widely used foundation for automated fingerprint verification is now the recognition of minute features. The ridge ending and ridge bifurcation were the most often utilized minutiae features for automated fingerprint verification. In order to properly identify their rightful owner, latent fingerprints must have distinguishable ridge characteristics. Presenting fingerprint evidence is important for legal proceedings and criminal case investigation processes. This review looked into fingerprint powders out of leftover materials like lemon and egg peels. These environmentally friendly substitutes worked well on various types of surfaces, demonstrating their potential as long-term solutions for forensic analysis. According to the studies of finding with the usage of natural powder fingerprints were developed successfully using various powders. Egg shell powder proved to be the most effective natural powder in terms of fingerprint results. This review gives idea about use of waste material and lessens the need for artificial chemicals making forensic procedures more sustainable.

Keywords: *Forensics, Genetics, STR Markers, DNA Profiling, Advancements*

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Introduction

Fingerprints are one of the most relevant part of evidences that can be obtained from any crime scene for the identification of criminal. In today's era it has become important to develop new methods preferably nondestructive for the development of crime scene. A fingerprint is mark made by the friction ridges of a human finger. Taking partial fingerprint from a crime scene is essential forensic science practice. Fingerprints on metal or glass surfaces are caused by a finger's grease and moisture. Ink or other materials can be purposefully applied from the peaks of the skin's friction ridges to a smooth surface, like paper, to produce full fingerprint impressions. Fingerprint cards usually record part of the lower joint areas of the fingers in addition to the imprints from the pad on the last joints of the finger and thumbs, which are usually documented in the records. Human fingerprints are appropriate as long-term indicators of a person's identity because they are intricate, almost one-of-a-kind, hard to change and persistent over the course of a person's life.. When someone wants to hide their identity, or when someone is dead or incapacitated and cannot identify themselves, like in the wake of a natural disaster, police or other authorities may use them to find them. Judges, academics, and the media have questioned their use as evidence. There are no set guidelines for point-counting techniques, and scholars have contended that there is no reliable statistical basis for fingerprint evidence and that the error rate in matching fingerprints has not been sufficiently examined **(Roberts, 2017)** There are three primary categories for fingerprints found at crime scenes primarily the Patent Prints, those patented fingerprints which are made up of dirt, ink, grease, and blood also known as visible fingerprints left on smooth surfaces after a hand comes into contact with blood, ink, or other liquids and transfers them to the surface are known as patent fingerprints. Secondly the Latent Prints where the impression of friction created by a finger's skin and palm is transferred to a surface is known as a latent imprint. Sweat and oil on the skin's surface result in latent fingerprints. In latent prints, fingerprints that are not visible to the human eye but are nonetheless present. Latent imprints are present on many different surfaces, but because they are latent, it is necessary to use fingerprint powders, chemical reagents, or other light sources to detect them because they are not readily visible. Lastly the Plastic Prints which are left on soft surfaces or items such as wax, soap, clay, or cheese **(Priyanka and Shabeena, 2022).**

Review of Literature

In forensic investigation and authenticity verification, latent fingerprints—the inadvertent impressions left at crime scenes—are thought to be extremely crucial. It is a very important tool that the legal law enforcement and forensic organizations to convict offenders. But because these impressions are unintentional, the quality of the prints that are lifted is typically worse. It is imperative to design new approaches to increase the robustness and reliability of the current techniques in order to enhance the overall performance of fingerprint recognition. As a result, a comprehensive review of the current techniques for latent fingerprint acquisition, enhancement, reconstruction, and matching is provided, along with an overview of the different benchmark datasets that can be used for research**.** Development of STR Markers

Ashutosh Tripathi et al., demonstrate, Brick powder is a novel technique used in the generation of latent fingerprints. Brick powder is applied to a variety of porous and non-porous surfaces, including painted walls, writable CDs, matchboxes, plastic glass, and regular mirrors. For the production of a latent fingerprint impression, use a wooden substrate, cash note, door handle, floor surface, book cover, sunglasses, and a moveable glass card. Because of the powder's color contrast, the current study's findings demonstrated how latent or invisible fingerprints can form on a variety of non-porous surfaces using brick powder. The powder work well on non-porous, light and dark-colored surfaces.

According to Kavitha Rajagopal's et al., 2021 research, latent fingerprints can be enhanced by using powdered eggshell dye. This technique replaces traditional fingerprint powders with an affordable and sustainable option using eggshells, a common waste product from homes.The powder that provides the best color contrast with a dusty surface will be chosen by the examiner. Furthermore, different kinds of powders are accessible for the development of latent prints. Among them are fluorescent and magnetic powders. In contrast, an invention or innovation has great value in the fields of science and other fields. Thus, the notion of augmenting the latent prints with waste material is investigated. Eggshells are produced in large quantities every day, making them a solid waste. Most eggshells end up in landfills, where they require expensive management. It is cost-effective to process the eggshell waste and turn it into new products. Eggshells can currently be used as fertilizer, biomaterial, biodiesel, and absorbent.

The simplest and quickest way to develop fingerprints is to use traditional fingerprint powder. It is also a crucial technique employed in the lab and the workhorse at the location of the crime. This study set out to investigate the differences in the physical characteristics of the fingerprint after six weeks of growth with different powders. Following the application of black magnetic and black fingerprint powder, the study compared the number of positive identifications of each "minutiae." The donor's latent fingerprints were placed on sanitized microscope slides. After 30 minutes, the following prints were applied. As much as possible, similar guidelines for pressure and deposition duration were created. Using both black fingerprint powder with a specific indication, which are both accessible, the slides were checked weekly at comparable interval for six weeks straight. You can use black magnetic powder for up to four weeks, while black fingerprint powders is only good for three weeks. The outcomes provided details employing both fingerprint powder for fingerprint development within a practical time range **(Omar and Laura, 2012).**

Bhargva et al., in 2023 show that a person's fingerprints are a vital component of their unique identification. When a finger comes into touch with any surface, human friction creates these ridges. The primary advantage of a fingerprint is its consistency throughout time. The impression made by the minute ridges that are visible on your fingertips is used in the fingerprint identification process. Fingerprints are unique because of a few distinctive characteristics. Fingerprints are typically discovered at crime scenes. Sweat and natural oils found in the crevices between fingertip ridges are brought to the surface by contact, resulting in these impressions. Fingerprints are more challenging to locate and retain since they are invisible. The methods utilized to make these prints include both chemical and physical ones. The research focused on using ophthalmic fiber glass powder on different surfaces to detect latent fingerprints, or unseen fingerprints, is presented in this study. Employed the ophthalmic fiber glass here and ground it into a powder to get latent fingerprints **(Bhargava *et al.*, 2023).**

Godara et al., in 2022 employed domestic waste organic materials, such as hibiscus and rose petals, to make powders that are used to make latent fingerprints. The powder particle adheres to moisture and sweat left on the palm, sole, and fingers, revealing the fingerprint's minutiae and improving visibility. Eventually the composition of the powder sticks to the ridges and the excess powder blows away. Here, the powder is multicolored, the patterns are discernible, and the outcome is amazing. The project's goal is to provide a safer, less expensive substitute for the conventional, dangerous, and expensive lab powders. These organic powders offer an affordable, non-toxic, easily accessible, and eco-friendly way to create latent fingerprints. It is a trustworthy method to utilize both now and in the future at crime scenes **(Godara *et al.*, 2022).**

Vuckovic et al., in 2022 research investigates the creation and properties of bio powders based on dextran and chitosan in order to determine whether or not they can be used to visualize latent fingermarks. Chitosan and dextran have a variety of pharmaceutical and medicinal applications, however there aren't many studies on their use as biopolymers in fingerprint powder. Two formulations based on chitosan and one based on dextran were generated via simple synthetic processes. Because of their tiny and uniformly distributed particles, the produced powder formulations adhered to the lipid residues and sweat discovered in the fingerprint trail with ease. The formulations were pre-tested on a glass surface, which is non-porous, and a rubber surface, which is semi-porous. The results demonstrated that, in addition to commercially available physical techniques and fingerprint powders, the obtained bio-based powders might be utilized to improve and detect latent fingerprints **(Vuckovic *et al.*, 2022).**

Rathinavel et al., in 2021, in this work, orange peel powder (OPP) was used as a filler in varying quantities (5% to 20% of weight) and polyvinyl alcohol (PVA) as a matrix to make bio composite films by the solution casting technique. The films underwent tensile testing, TGA, DSC, FT-IR, and XRD investigations. The FT-IR and XRD results demonstrate the smooth dispersion of PVA and OPP, while the samples exhibit thermal stability up to 350°C and improved tensile properties from 6.20 MPa to 7.80 MPa when OPP was added. These biofilms are superior to conventional packaging materials and can be used as environment friendly packaging materials **(Rathinavel and S. S., 2020)**

The Fruit peel is extracted in large quantities from the food processing sector as residual materials, which, if not managed carefully, pollute the environment. The goal of this work was to identify bioactive components and investigate antioxidant properties of three distinct fruit peel wastes—orange, mango, and pomegranate—that were gathered from fruit processing facilities. The primary research topics were the total phenolic and total flavonoid content (TFC) of peel extracts in three distinct solvent systems: aqueous–methanolic (20:80, v/v), ethanolic, and aqueous. The levels of antioxidant activity in each type of solvent vary, with PP > MP > OP having the highest levels. An analysis of the

Pearson's correlation coefficient revealed a strong connection between antioxidant activity and TPC. The high amounts of gallic acid, salicylic acid, chromogenic acid, rutin, and catechin observed in aqueous–methanolic (20:80, v/v) extracts of PP may account for its higher antioxidant activity. In conclusion, the study's results show that PP waste contains strong antioxidants and might be added to commercial feed to aid animals experiencing oxidative stress **(Ghosh *et al.*, 2019).**

Result

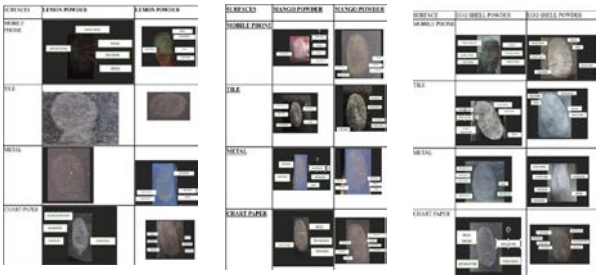

Figure No. 1: Result of Fingerprint with Mango Powder, Lemon Powder, Egg Shell Powder on Non – Porous and Porous surfaces of volunteers impression print.

An inventive and environmentally friendly method in forensic science is the creation of fingerprint technology from leftover materials, such mango peel. According to the research papers studied, powders made from waste materials, especially mango peel and egg shell powder can be utilized to create latent fingerprints on a variety of surfaces, such as paper, metal, glass, and plastic. Utilizing waste materials decreases costs and makes forensic procedures more accessible, particularly in resource-constrained areas. It also lessens environmental effect by recycling organic waste that would otherwise contribute to pollution. In addition to paving the door for future study into additional organic waste materials, this methodology also supports global sustainability goals by streamlining preparation and application procedures and standardizing practices to guarantee efficacy and dependability. The accomplishment of this study shows that eco-friendly procedures can be included into forensic workflows without sacrificing precision or effectiveness. Innovation and sustainability are combined in forensic science with the invention of fingerprint technology from waste materials, which represents a paradigm change. This research not only solves accessibility and cost limitations in forensic analysis, but also tackles environmental problems by turning waste goods like potato peels into efficient fingerprinting agents. The method's reliability and applicability are shown by its ability to produce ridge patterns that are as clear as those produced by older procedures. Furthermore, the fact that it may be applied to a variety of surfaces indicates that it has the potential to be widely used in a range of forensic scenarios. Beyond its immediate uses, this green methodology establishes a standard for integrating eco-friendly practices into forensic techniques, supporting larger initiatives aimed at environmental stewardship. With additional research, the efficiency and reliability of forensic fingerprint analysis will be further enhanced while minimizing ecological impact through the discovery of waste-derived materials and the development of methodologies. The ability of interdisciplinary thinking to propel sustainable innovation in forensic science and beyond is ultimately demonstrated by the invention of fingerprint technology from waste material.

Beyond its immediate implications in forensic research, the invention of fingerprint technology from waste materials sparks a complex debate. Fundamentally, these invention upends conventional wisdom by turning resources that were previously deemed trash into useful assets for the good of society. Researchers have opened a new path for ecological and economical forensic investigation by utilizing items like mango peels, egg shell poweder, which are often thrown away.

Conclusion

According to the above mentioned studies carried out by various researchers in different years it can be concluded that natural waste materials can be used as an alternative powders for the development of latent fingerprints. Further it can also be concluded that powders should be used by remembering the color of the surface where the prints are present so that a proper contrast can be created for clear visibility of the fingerprints. One drawback of the natural peel powders for the development of fingerprints is that some of them have a lesser shelf life i.e. they cannot be preserved for a longer time which makes it difficult for the developer to store the powder for longer time duration also, keeping the developed print for much longer time is not possible.

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