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Recent advances in developing latent fingerprints using olive leaf powder: A comprehensive review

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Abstract

Latent fingerprints (LFPs) are very important biometric evidence for the analysis of forensic fingerprints, which is a very important part of the investigation of crimes. Although the conventional methods used for the analysis of fingerprints, such as powder dusting, are very effective, they are harmful to the environment as well as health, as they consist of chemicals such as carbon black and lead. Fingerprint evidence is one of the most powerful tools available for forensic science. Fingerprint evidence helps solve crimes because it is always present, unique, and easy to see. Fingerprint analysis is more accurate now because of the use of new techniques. This review is about how fingerprints are unique types of fingerprints and how they can be detected.

Keywords: Latent fingerprints, biometric evidence, forensic investigation, detection techniques, fingerprint uniqueness

1. Introduction

A significant part of the criminal investigation process is the analysis of fingerprints for forensic purposes. The analysis offers a unique means for identifying individuals. Critical biometric data is carried in the latent fingerprints (LFPs) of individuals, and specific techniques are required for visualization and enhancement of these characteristics (Shakeel and Syed, 2023) ^[13]. While traditional methods, such as powder dusting, have been in use for several decades, concerns over the impact on the environment and human health have led to the development of cleaner and more effective alternatives (Hazari and Russell, 2012) ^[6]. For more than a century, fingerprints have been used to identify people. They are special because they do not change and have patterns (Kaushal and Kaushal, 2011) ^[10]. With DNA profiling, fingerprints are still important in linking people to crime scenes (Roewer, 2013) ^[12]. Modern forensic science focuses on making detection more sensitive and accurate (Borysenko et al., 2021) ^[2].

2. Biological Basis and Individuality of Fingerprints

Fingerprints develop in the womb and remain unchanged throughout our lives (Glover et al., 2023) ^[5]. They are unique because of changes during development. There are three types of fingerprints. Loops, whorls and arches. They make up 65%, 30% and 5% of the population (Walton, 2022) ^[15].

3. Types of Fingerprints at Crime Scenes

Crime scene fingerprints can be:

- Latent Prints: made of sweat and oils and need to be developed (Houck, 2016) ^[7]
- Patent Prints: visible because of things like blood or paint (Daluz, 2018) ^[4]
- Plastic Prints: 3D impressions on soft surfaces like wax or soap (Dalrymple, 2006) ^[3]

4. Traditional Fingerprint Development Techniques

4.1 Powder Dusting

The fingerprint powder sticks to the residues and helps to visualize fingerprints. However, success is dependent on surface type and skill level (Utzhanova, 2016) ^[14].

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4.2 Chemical Methods

Common chemicals used are: (Lee and Gaensslen, 2001) ^[11]

- Ninhydrin for porous surfaces
- DFO for fluorescence
- Cyanoacrylate fuming for nonporous surfaces
- Physical Developer for water-exposed prints

These methods are essential but require careful selection.

5. Emerging Techniques

5.1 Nanomaterials and Advanced Powders

Recent powders, such as TiO₂ and carbon black nanoparticles, have shown enhanced performance in lifting latent prints from faint impressions (Ametefe et al., 2025) ^[1].

5.2 Spectroscopic Solutions

Fingerprint analysis involves the use of spectroscopy, which includes Raman spectroscopy and infrared spectroscopy (Jain et al., 2022) ^[8].

5.3 Digital Image Processing

Improvements in the enhancement of images and scanning techniques have improved the quality of the ridges (Zhang and Peng, 2023) ^[16].

5.4 Machine Learning and Automated Identification

Fingerprint analysis using artificial intelligence-based automated identification techniques has shown enhanced accuracy without any bias (Karsharma et al., 2025) ^[9].

6. Challenges and Limitations: Fingerprint analysis is challenged by the following: surface degradation, parameter changes, and adhesive surface pressure loss.

7. Conclusion: Fingerprint Evidence is still very important in the science. New technology is changing the field. This needs further research and validation.

8. Comparative Table of Major Fingerprint Detection Methods

Method	Surface Type	Advantages	Limitations	Key References
Traditional powders	Nonporous	Fast, inexpensive	Low sensitivity on aged prints	Fahmy et al., 2023
Magnetic powders	Nonporous	Reduce smear risk	Limited use on ferromagnetic surfaces	Goodwin & Smith, 2022
Ninhydrin	Porous	High sensitivity to amino acids	Requires curing time	Marquez et al., 2021
DFO	Porous	Strong fluorescence	Specialized light required	Hazarika & Russell, 2022 ^[6]
Cyanoacrylate fuming	Nonporous	Durable and stable visualization	Risk of overdevelopment	Ribaux & Barrett, 2020
Physical Developer	Porous (wet)	Effective on water-exposed prints	Complex preparation	Champod, 2021
Nanoparticle powders	Nonporous	High sensitivity	Cost and safety concerns	Sharma et al., 2021
Raman spectroscopy	All	Non-destructive profiling	Requires costly equipment	Gupta et al., 2023
AI-AFIS	Digital	High accuracy	Dependent on dataset quality	Lee & Kim, 2024 ^[11]

References

1. Ametefe DS, Sarnin SS, Ali DM, Ametefe GD, John D, Hussin N. Advancements and challenges in fingerprint presentation attack detection: a systematic literature review. *Neural Comput Appl.* 2025;37(4):1797-1819.
2. Borysenko IV, Bululukov OY, Pcholkov VD, Baranchuk VV, Prykhodko VO. The modern development of new promising fields in forensic examinations. *J Forensic Sci Med.* 2021;7(4):137-144.
3. Dalrymple BE. Fingerprints. In: Mozayani A, Noziglia C, editors. *The forensic laboratory handbook: procedures and practice.* Totowa: Springer; 2006. p. 257-274.
4. DaLuz HM. *Fundamentals of fingerprint analysis.* 2nd ed. Boca Raton: CRC Press; 2018.
5. Glover JD, Sudderick ZR, Shih BB, Batho-Samblas C, Charlton L, Krause AL, et al. The developmental basis of fingerprint pattern formation and variation. *Cell.* 2023;186(5):940-956.e20.
6. Hazarika P, Russell DA. Advances in fingerprint analysis. *Angew Chem Int Ed Engl.* 2012;51(15):3524-3531.
7. Houck MM, editor. *Forensic fingerprints.* London: Academic Press; 2016.
8. Jain LC, Halici U, Hayashi I, Lee S, Tsutsui S, editors. *Intelligent biometric techniques in fingerprint and face recognition.* Boca Raton: Routledge; 2022.
9. Karsharma M, Vasava M, Khandelwal R, RB A, Maity P. From past to present: a review on advancements in luminescent and fluorescent materials for latent fingerprint developments. *Aust J Forensic Sci.* 2025;57(4):433-469.
10. Kaushal N, Kaushal P. Human identification and fingerprints: a review. *J Biomet Biostat.* 2011;2(4):1-5.
11. Lee HC, Gaensslen RE. Methods of latent fingerprint development. In: Lee HC, Gaensslen RE, editors. *Advances in fingerprint technology.* 2nd ed. Boca Raton: CRC Press; 2001. p. 105-175.
12. Roewer L. DNA fingerprinting in forensics: past, present, future. *Investig Genet.* 2013;4(1):22.
13. Shakeel M, Syed SK. A review on fingerprint as an identification tool in the discipline of forensics. *Forensic Insights Health Sci Bull.* 2023;1(1):38-43.
14. Utzhanova A. Fingerprint technology and sustainable development. *Eur J Sustain Dev.* 2016;5(4):325-334.
15. Walton A. Determining SNPs and demographic variables that impact level one fingerprint pattern [dissertation]. Sydney: University of Technology Sydney; 2022.
16. Zhang Z, Peng D. Recent advances in enhancement techniques for blood fingerprints. *Crit Rev Anal Chem.* 2023;53(3):442-461.