

Quality of Latent Fingerprint on Contaminated Porous Surface Over 1 Month Exposure

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Structured Abstract

Background: Recovering latent fingerprints from crime scenes is vital, but their quality and recoverability depend on various factors including sweat composition, substrate, and environmental conditions. While much research focuses on environmental effects on fingerprint aging, there's limited attention on how pre-deposition substrate contaminants influence degradation over time. This study addresses this gap by investigating the effect of pre-deposition soil contamination on porous substrates (paper) and its influence on fingerprint quality over a 28-day aging period.

Methods: Paper samples were buried in soil for varying durations (1 day, 3 days, 1 week, 1 month, 2 months) prior to fingerprint deposition. A single donor deposited natural latent fingerprints under standardized conditions. Ninety fingerprint samples were aged under laboratory conditions for up to 28 days. Fingerprints were developed at five post-deposition intervals (Day 0, 7, 14, 21, 28) using ninhydrin. Fingerprint quality was assessed using the CAST scoring system. Non-parametric statistical analyses, including Kruskal-Wallis and Friedman tests, were performed.

Results: The impact of substrate contamination on latent fingerprint quality was not always immediate but intensified significantly over time. This indicated that the presence of contamination made fingerprints more susceptible to degradation as they aged, acting synergistically with the natural aging process. Initial fingerprint quality on contaminated paper often appeared similar to clean surfaces. However, over 28 days, fingerprints on contaminated substrates showed significant and progressive degradation, unlike control samples. Specifically, substrates buried for 3 days or 1 week showed the most noticeable and rapid quality drop. Kruskal-Wallis H-tests confirmed statistically significant differences in quality across substrate groups from Day 14 onwards. Friedman tests showed significant time-dependent degradation on 1-Day, 3-Day, and 1-Week buried substrates.

Conclusion: This study conclusively demonstrates that pre-deposition substrate contamination has a significant and progressively intensifying impact on latent fingerprint quality. This highlights the crucial need to consider a substrate's environmental history in forensic evidence evaluation. The findings advance the understanding of latent fingerprint aging dynamics and offer practical implications for crime scene recovery protocols and future development of aging models. Future research should expand the aging period and investigate broader contaminant variables.

Keywords: Latent Fingerprints, Fingerprint Quality, Contaminated Porous Surfaces, Soil Burial, Forensic Evidence.

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