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Discipline: 2.15. Forensic Microbiology & Microbiomics

Integrating Microbial Metabarcoding and MALDI Imaging to Enhance Finger Mark Recovery from Living Skin

Noemi Procopio[1*], Simona Francese[2], Michele Di Nunzio[3], Anna Franzoni[4], Sarah Gino[5], Jillian Newton[2], Komang Ralebitso Senior[6], Andrea Bonicelli[1], Jane Sanderson[7], Andy Nixon[8], Stuart Nicholls[8]

1 Research Center for Field Archaeology and Forensic Taphonomy, University of Lancashire, Preston, UK; 2 Biomolecular Sciences Research Centre, Sheffield Hallam University, Sheffield, UK; 3 Forensic Genetics Laboratory, Legal Medicine Unit; Department of Medicine, University of Barcelona, Barcelona, Spain; 4 COPAN Italia S.p.A., Brescia, Italy; 5 Department of Health Sciences, University of Eastern Piedmont, Novara, Italy; 6 School of Pharmacy & Biomolecular Sciences, Liverpool John Moores University, Liverpool, UK; 7 West Midlands Regional Innovation and Research Group, Birmingham, UK; 8 West Midlands Police, Birmingham, UK

* Corresponding author: Noemi Procopio; nprocopio@lancashire.ac.uk

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Background: Human skin is a challenging surface for latent fingerprint recovery, and limited success in obtaining ridge detail or usable DNA is a major gap in forensic science. Guidance on fingerprint recovery from skin is scarce, creating difficulties especially in Violence Against Women and Girls (VAWG) cases, such as sexual assaults and strangulation, where rapid and reliable identification is essential. Enhancing these capabilities benefits Murder Departments and Public Protection Units. Aligned with the NPCC Science & Technology Strategy "Identification & Tracing," this project investigates whether microbiome, proteomic, and lipidomic markers from fingerprints can aid suspect identification when traditional approaches fail.

Methods: One hundred donors deposited fingerprints on acetate sheets using a standardised protocol. Fingertips and fingerprints were swabbed once per day for three days and again after one month to assess microbial transferability and persistence. Microbiomes were profiled with QIAGEN DNeasy PowerSoil Pro Kits and 16S rRNA sequencing on an Illumina MiSeq. MALDI-MS workflows were optimised to detect microbial peptides and lipids. Four bacterial isolates identified via metabarcoding were cultured, mixed in controlled ratios, and deposited onto glass slides or prosthetic fingerprints on glass. Peptides were analysed after lysis, digestion, and matrix application on a Synapt G2 HDMS system, while intact lipids were examined using LipidMaps.

Results: Preliminary data revealed stable, donor-specific microbial signatures, with bacteria uniquely associated with individuals and detectable across fingertips. Pilot studies showed these microbes transfer from skin to fingerprints, supporting their potential for individualisation. Microbial profiles also correlated with lifestyle traits, health factors, and biological sex. Comparison between fingertips and fingerprints confirmed microbial transfer. MALDI-MS analyses on real fingerprints are ongoing and will be presented at the conference.

Conclusions: Fingerprint microbiomes are transferable and sufficiently individualised to support forensic intelligence. Combined metabarcoding and MALDI-MS approaches offer strong potential when fingermark or DNA evidence is limited.

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