B169 Lifestyle Determination From Chemical Identification in Fingerprints

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After attending this presentation, attendees will better understand Mass Spectral Imaging (MSI) applications to latent fingerprint analysis. Specifically, this presentation will focus on the importance of all exogenous compounds present in latent fingerprints.

This presentation will impact the forensic science community by improving understanding of the usefulness of MSI for the identification of chemical compounds in latent fingerprints. Most importantly, the exploitation of all exogenous compounds will allow the forensic science community to compile the lifestyle of an unknown fingerprint donor.

We are surrounded by chemicals, many of which are influenced by the lifestyle of an individual, and can be studied by metabolomics tools.[1,2] This lifestyle characterization approach can be extended to latent fingerprints. MSI has been applied to chemical imaging of fingerprints and visualizing endogenous and exogenous compounds. Previous work for exogenous compounds has focused on drugs and explosives, but little has been done to exploit other compounds that can be used as lifestyle markers.[3,4] The focus of this work was to compile potential lifestyle markers of a fingerprint and develop a method that can efficiently analyze a broad range of exogenous compounds.

Consumer products were applied per product instructions, and a fingerprint was then deposited on a glass slide pre-cleaned with methanol. Citrus fruits, alcohol, and food oil samples were touched to mimic consumption, a spill, or the handling of foodware before making a fingerprint. Gold and silver targets were sputter coated for matrix deposition at 20mA for ten and five seconds, respectively. A linear ion trap-Orbitrap™ mass spectrometer with a Matrix-Assisted Laser Desorption/Ionization (MALDI) ion source was coupled with a 355nm Nd:YAG laser. Imaging and profiling of fingerprint samples was conducted with a 100µm raster step, ten laser shots per raster step, and a 30µm laser spot size over the m/z range of 50-1,000. For multiplex imaging, a spiral raster step was employed for fragmentation of known precursor masses.[5] Positive and negative ion modes were employed for profiling, imaging, and multiplex imaging.

In the analysis of latent fingerprints containing bug spray and sunscreen, the variations in active ingredients allowed brand differentiation. The differences in the spectra of three bug spray brands were easily correlated to the active ingredient in each. While most sunscreens can be differentiated based on the active ingredient list, two brands containing the same active ingredients were isolated based on the relative abundances of each compound. The spectra of Coppertone® and Neutrogena® sunscreens were dominated by octocrylene, but avobenzone was only abundant in Neutrogena®. Octocrylene, avobenzone, and octinoxate proved to be key compounds in distinguishing sunscreen brands.

Human fingerprints naturally contain Triacylglycerols (TGs), secreted from sweat glands, but those from plants have distinct patterns of saturation on fatty acyl chains. As expected, three cooking oils and a vegetable spray revealed distinct TG patterns distinguishable from human TGs. The most abundant TG species in olive and canola oil is TG 54:3 as a sodiated adduct at *m/z* 907, and TG 54:4 at *m/z* 905 in sesame oil, which are present only in minimal abundance in natural fingerprints. Olive oil had a narrow unsaturation pattern, whereas sesame and canola oil exhibited very broad unsaturation patterns. Vegetable spray is easily identified in fingerprints due to multiple unique TGs and the presence of phosphatidylcholines.

Fingerprints contaminated with alcohol were commonly identified based on the presence of sugars, ethyl palmitate, ethyl myristate, and glycerol. The analysis of wine proved to be the most informative in negative mode, based on the presence of gallic, tartaric, succinic, malic, and galacturonic acids. Fingerprint spectra containing beer were dominated by various sugars, including a unique malt starch, from the malting and brewing process.

The chemical compounds in mandarins, lemons, and limes were explored. Citric acid was present in all three, but consistently present at higher relative abundance in the lemons and limes. Mandarin fingerprints also contained malic acid, naringenin, tangeretin, and nobiletin, which were not present at detectable levels in the lemons and limes.

This study proves that a broad range of exogenous compounds can be detected and confirmed in latent fingerprints using MSI. A multiplex imaging method was applied to the analysis of exogenous compounds in latent fingerprints. Each compound in the latent fingerprints was identified by accurate mass and Tandem Mass Spectrometry (MS/MS). The compilation of the detected exogenous compounds could lead to a lifestyle determination of the unknown fingerprints source.

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MALDI-MSI, Fingerprints, Lifestyle

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