D35 Analysis of Triacylglycerols in Fingermark Samples as a Dating Technique by Laser Desorption/Ionization Time-of-Flight Mass Spectrometry

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After attending this presentation, attendees will understand: (1) how TAGs in fingermark samples can be detected; (2) the mechanism and duration of their degradation; (3) and examples of decomposition over different experimental conditions.

This presentation will impact the forensic science community by providing a reliable way to detect the degradation products of TAGs in fingermark samples. This detection could serve as a potential dating method for fingermarks. At the present time, no established method is accepted for dating fingerprints or fingermarks.

The chemical composition of fingermarks could potentially be important in the investigation of criminal activity. This includes application of a possible dating method to place an individual identified through a fingerprint at the time of a crime. Determination of the age of a fingermark, in particular, would be useful to confirm or dispute a suspect's alibi. For example, an individual could assert that a fingerprint recovered from a crime scene was present for weeks before the crime was committed. Determining that the print was left hours before the offense could be critical in establishing a time-line of events and a subsequent conviction

Fingermarks are the recovered traces of material transferred to other surfaces upon contact. The material transferred is a complex mixture of chemicals, mostly lipids including triacylglycerols (TAGs). In this study, fingermark samples containing TAGs were analyzed using laser desorption/ionization (LDI) time-of-flight mass spectrometry (TOF MS). Only LDI appeared to be useful for this application while conventional matrix-assisted laser desorption/ionization (MALDI) TOF MS was not. Analysis of fingermark samples exposed to light conditions on a stainless steel target indicated the formation of TAG degradation products. As the sample degraded, additional peaks were observed in the mass spectrum particularly in the m/z range of 650-750. The decrease in relative intensities for some TAGs occurred after exposure to light for less than 12 hours with almost complete degradation taking place after 72 hours. These products were not detected in samples exposed to dark conditions. TAGs that decreased in intensity corresponded to those previously identified as having at least one unsaturated fatty acid. Other TAGs that were still present after 72 hours were identified as containing all saturated fatty acids. Monitoring these changes in the TAGs over time and under different conditions could establish a consistent pattern for dating applications.

Analysis of an unsaturated TAG standard (triolein, C57:3) was used for comparison. After exposure of this sample to the same conditions as fingermarks, decomposition was observed under light conditions. Tandem mass spectrometry was used to identify/confirm selected TAG degradation products. Formation of bound C8:0 and C9:0 aldehydes and carboxylic acids were observed. These products are consistent with those found in fingermark degradation products.

Fingermark samples were also allowed to undergo degradation on alternative sample surfaces to determine if the process is rate dependent upon the sample medium. Comparison of different surfaces, as would be the case for fingermarks collected at crime scenes, is thus important for determining degradation rates. Samples were allowed to degrade on surfaces of glass, plastic, and wood under light and dark conditions. These samples were then analyzed in 12 hour increments for 60 hours by LDI-TOF MS for comparison to the stainless steel target samples.

Fingermarks, Triacylglycerols, LDI-TOF MS

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