

Forensic Analysis of Lipstick Stains Using ATR-FTIR Spectroscopy

Wan Anis Syafiqah Megat Shariffudin^a, Hamizah Md Rasid^{ab*}

Structured Abstract

Background: Lipstick smears are frequently found as trace evidence in crime scenes due to their easily transferable nature. It can be examined to prove physical contact between the suspect and the victim and can be used as collaborative evidence. Thus, it is necessary to characterize and discriminate between lipsticks from various brands on different substrates.

Methods: This study applied each liquid lipstick directly to the ATR crystal. To study the effect of substrate, the samples were applied on glass and cotton cloth before the ATR-FTIR analysis. Chemometric methods such as principal component analysis (PCA) and hierarchical cluster analysis (HCA) have been used along with ATR-FTIR spectroscopy. The multivariate data analysis was carried out using the Unscrambler X software.

Results: PCA makes the result analysis more straightforward and aids in identifying the data's most significant component. All ten lipstick samples are arranged in an obvious cluster. Then, HCA divides things into clusters of related objects to confirm the PCA results which displayed 9 clusters correlating to each brand. The results suggest lipstick analysis is tricky on cotton cloth and glass substrate. The exact source of the lipstick stains on the substrates could not be determined. Therefore, lipstick samples directly applied onto the crystal may be discriminated against, but are unable to when smeared on a substrate.

Conclusion: This study effectively used ATR-FTIR spectroscopy together with the chemometric approach to differentiate between the lipstick samples. HCA separates the data into clusters of similar items to corroborate the PCA results, while PCA makes the result analysis easier to understand. While the analysis of substrate effects on the lipstick samples in this study was proven difficult.

Keywords: ATR-FTIR, lipsticks, chemometrics, PCA, HCA

*Correspondence: hamizah7708@uitm.edu.my

^aSchool of Chemistry and Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia

^bMultifunctional Nanoporous Material (MULNA), Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia