Forensic Analysis of Eyeshadows using ATR-FTIR Spectroscopy and Chemometrics

Nurul Aliah Fadhlina Azhar[a], Hamizah Md Rasid[a,b*]

Structured Abstract

Background: Eyeshadows are frequently used and easily transferred; thus, it is possible that they will be found as important trace evidence at the crime scene. Criminal cases can be resolved with the help of this evidence, which can establish a connection between the victim, the suspect, and the crime scene. Differentiation of different brands of eyeshadows and classification of eyeshadow stains on various substrates needs to be done.

Methods: In this study, neat eyeshadows were placed directly on the ATR crystal, one at a time. As for the substrate study, eyeshadows were smeared on cotton cloth and glass before the ATR-FTIR analysis. Attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy in combination with chemometric methods such as principal component analysis (PCA) and principal component analysis-linear discriminant analysis (PCA-LDA) has been used. Unscrambler X software was used for the multivariate data analysis.

Results: Pattern recognition in the data has been accomplished using PCA. The clustering of triplicates of all 10 eyeshadow brands can be seen clearly. For classification purposes, PCA-LDA was used and the calibration accuracy was 100% and the validation accuracy was 45%. In the current study, a preliminary substrate study has been carried out. The findings imply that substrates like cotton cloth and glass make it difficult to analyse eyeshadows. Some eyeshadow stains found on substrates could not be linked to their original source. Hence, neat eyeshadow samples can be discriminated against, but if it is smeared on substrates, the discrimination cannot be achieved.

Conclusion: ATR-FTIR spectroscopy assisted by chemometric technique was successfully employed in this study to distinguish between the brands of neat eyeshadow. Pattern recognition was made easier by PCA, and PCA-LDA made it possible to interpret the results of spectroscopic data with greater statistical assurance. It is found that there are effects of substrate on the eyeshadow samples that hindered the analysis in this study.

Keywords: Eyeshadows, ATR-FTIR, PCA, LDA, Differentiation

*Correspondence: hamizah7708@uitm.edu.my

[a] School of Chemistry & Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia

[b] Multifunctional Nanoporous Material (MULNA)