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Authentication analysis of animal fats adulteration in nail polish simulation using Raman spectroscopy coupled with chemometrics

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Abstract
Cosmetics are being used daily by many people, and their consumption is on the rise every year. These products are adulterated with cheaper alternatives to increase their profit. As more cosmetics are available in the market, the authenticity of halal cosmetics has raised much concern among Muslim consumers throughout the world. Therefore, authentication analysis of cosmetic products is urgently needed. This study was conducted to detect beef tallow (BT), chicken fat (CF), lard (LD), and mutton fat (MF) in nail polish using Raman spectrometry combined with chemometrics. Partial least square-discriminant analysis (PLS-DA) and hierarchical cluster analysis (HCA) were successfully used to differentiate animal fats into four subclasses. In addition, partial least square (PLS) and orthogonal PLS (OPLS) regression were adequate to detect and predict the levels of BT, CF, LD, and MF in nail polish with R2> 0.990 both in calibration and validation models. The best prediction model for BT was from OPLS at the wavenumber range of 100–3200 cm−1 with R2> 0.990 and RMSEC as well as RMSEP lower than 2.0 %. Meanwhile PLS model demonstrated the best model to predict CF, LD, and MF was the PLS with R2> 0.990 and RMSEC as well as RMSEP around 1–2.40 %. This study revealed the potential application of Raman spectroscopy in combination with chemometrics as an effective and efficient technique for authenticating nail polish base formulation adulterated with animal fats.

Author Keywords
Animal fats; Chemometrics; Cosmetic; Nail polish; Raman spectroscopy

Index Keywords
Hierarchical clustering; Animal fat, Authentication analysis, Beef tallows, Chemometrices, Cosmetic products, Fat adulterations, Nail polish, Partial least squares discriminant analyses (PLSDA), Partial least-squares, Raman spectrometries; Raman spectroscopy

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