Summary

The demand for berry seed oils as food supplement, nutraceutical, and cosmetic products were observed in the recent years. Despite the growing interest, consumers remain vulnerable to fraud due to the lack of specific regulation for berry seed oils. To address the gap, the main aim of this work was to develop rapid and reliable methods for assessing the authenticity of berry seed oils based on their physicochemical, thermal, and spectroscopic profiles. The pioneering nature of this work lies in using the entire dataset of DSC and FTIR profiles as untargeted analytical methods to address significant authenticity issues related to oil freshness, adulteration, and label transparency.

This study was divided into three main stages: method optimisation of thermal and spectroscopic techniques, physicochemical characterisation of fresh and stored oils, and authenticity assessment of berry seed oils. In the first stage of research, it was found that lower seed quality and the clarification process of oil negatively affected oxidative stability and antioxidative properties. However, no differences in DSC phase transition profiles were observed in relation to the clarification process. The scanning rate affected the melting and crystallization DSC profiles of oils, and the melting profile obtained at a scanning rate of 5 °C/min was considered the most useful for further authenticity studies of the oils. Among the spectroscopic methods, FTIR was considered more informative than UV-VIS spectroscopy for further studies on the discrimination of oils. Using the optimised methods, three main authenticity issues were addressed: oil freshness, commercial oil screening, and label clarity regarding the declaration of extraction methods.

The physicochemical characteristics revealed distinct properties of each type. Blackcurrant seed oils had the higher content of carotenoids, chlorophylls and γ-linolenic acid, while raspberry seed oils exhibited the highest antioxidant activity (DPPH), tocopherols content and thermo-oxidative stability (OIT). In turn strawberry seed oils contained the highest amount of α-linolenic acid. All berry seed oils were thermally stable during one year of storage, as indicated by the OIT index, despite the reduction of antioxidants and deterioration in quality.

The storage time of oils was determined by assessing changes in their volatile profiles using Flash GC E-Nose coupled with PLSR models. During commercial oil screening, optimised PLS-DA models based on DSC and FTIR data performed well in classifying oils according to their botanical origins. The DSC and FTIR dataset complemented each other in presenting typical characteristics of berry seed oils from different extraction methods. A novel approach of low-level data fusion from both DSC and FTIR datasets was implemented, creating

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a fused dataset referred to as "DSC-FTIR". The fused dataset was used for rapid classification with the SIMCA model. This model from DSC-FTIR dataset outperformed models built based on single analytical methods in classifying berry types and extraction methods.

This work provides essential information about developing untargeted authenticity assessment methods specifically for berry seed oils. The knowledge gained from this study can serve as a foundation for food policy makers to establish the regulatory standards for berry seed oils.

Keywords: Berry seed oils, authenticity, differential scanning calorimetry (DSC, Fourier transform infrared spectroscopy (FTIR), chemometrics.

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