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Application Note

Rapid Discrimination of Authentic Honey and Adulterants Using RADIAN ASAP

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This is an Application Brief and does not contain a detailed Experimental section.

Abstract

Honey, the natural sweetener produced by bees is more expensive than syrup due to higher nutritional content and health benefits. Multiple techniques are often required to differentiate honey and syrup due to similar physicochemical characteristics. This study demonstrated the application of a quick and easy ambient mass spectrometry technique for rapid discrimination of authentic honey, potential adulterant, and adulterated honey. The samples were directly introduced into the ionization chamber of RADIAN ASAP for mass profiling with minimal sample preparation. The samples were clustered into three classes indicating the potential application for detection of syrup adulteration in honey. RADIAN ASAP and LiveID Software together, offered a quick testing approach for the discrimination of honey and plant-based syrups, which can be useful for point of control purposes in raw ingredient screening as part of the food trading and manufacturing process.

Benefits

- Quick and easy fingerprinting tool for food manufacturing quality control, including non-MS experts
- Simple and intuitive LiveID Software operation for chemometric model development
- Rapid discrimination of authentic honey and adulterants using chemometrics model

Introduction

Honey is a natural sweetener with high nutritional content and health benefits, which often dictates higher market price than plant-based and synthetic syrups.[1] It is challenging to visually differentiate honey and syrups due to similar color, sweet taste, and sticky texture, making honey one of the most vulnerable commodities to economic adulteration.[2] The differentiation of honey from syrups often rely on skilled sensory panelist and laboratory testing using multiple techniques which includes chromatography, ICP, photometry, and melissopalynology methods to determine the markers and substances specific for the added syrup or the production process.[1,2] Untargeted approaches are now popular including the use of spectroscopy (e.g. NMR and NIR), mass spectrometry (MS), and isotope ratio MS (^{13}C IRMS using EA and LC-IRMS), which require considerable level of expertise and experience.[2,3] Ambient mass spectrometry, requiring minimal sample preparation, enables direct sampling and ionization of the sample at ambient conditions and proved to be a useful tool for rapid mass profiling for food authentication purposes.[4-7] This study demonstrated the

discrimination of authentic honey, adulterant, and honey adulterated with syrup using RADIAN ASAP with LiveID Software.

Results and Discussion

A total of 11 authentic honey samples, five adulterants and one honey sample adulterated with 35% syrup were analyzed. The samples were solvent extracted to reduce sample complexity before introducing into the RADIAN ASAP source by dipping extract with a glass capillary.

Chemometric models were built in LiveID v.2.0 Software on the mass spectra collected from these samples. The model was calculated using the mass region of *m/z* 200 to 800. The three dimensional PCA showed a total variance of 90% from the first three principal components (Figure 1A), and the samples were successfully separated into three classes by PCA-LDA: authentic honey, adulterant, and adulterated honey (Figure 1B). First component (LD1) separated the authentic honey from adulterants, while second component (LD2) separated the adulterated honey from authentic honey.

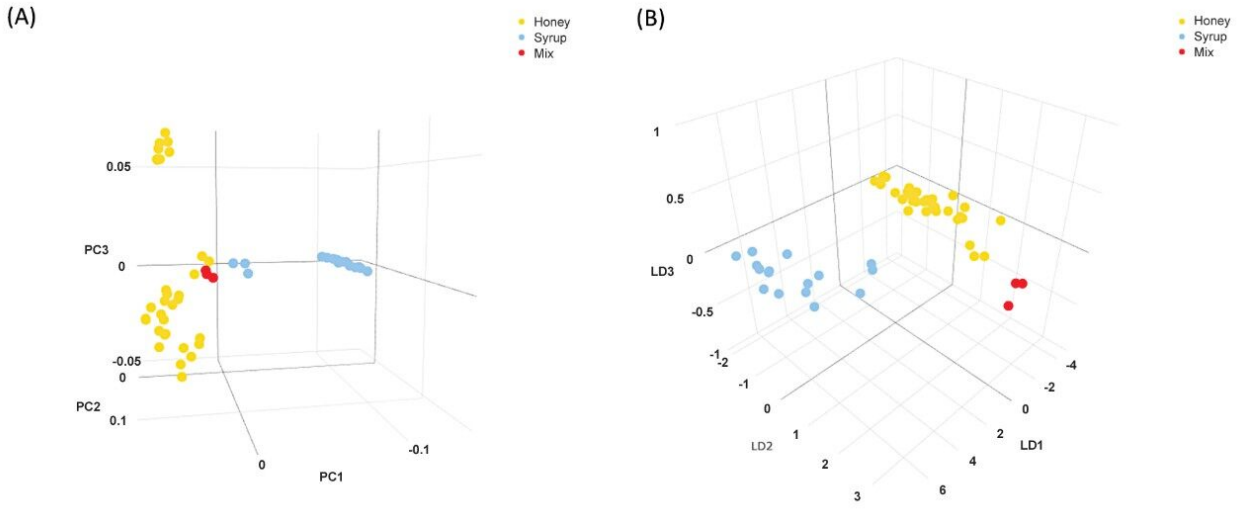

Figure 1. Unsupervised PCA (A) and supervised PCA-LDA (B) scores plots generated from LiveID Software on experimental samples.

Figure 2 showed the loading plots of first two components and the ions that contributed to each principal component. Two fingerprint regions namely *m/z* 200–350 and *m/z* 500–700 were identified to explain the

difference in PC1 and PC2 respectively. RADIAN ASAP allows quick screening of differences in samples without tedious sample preparation before further detailed study using advanced LC-MS technique.

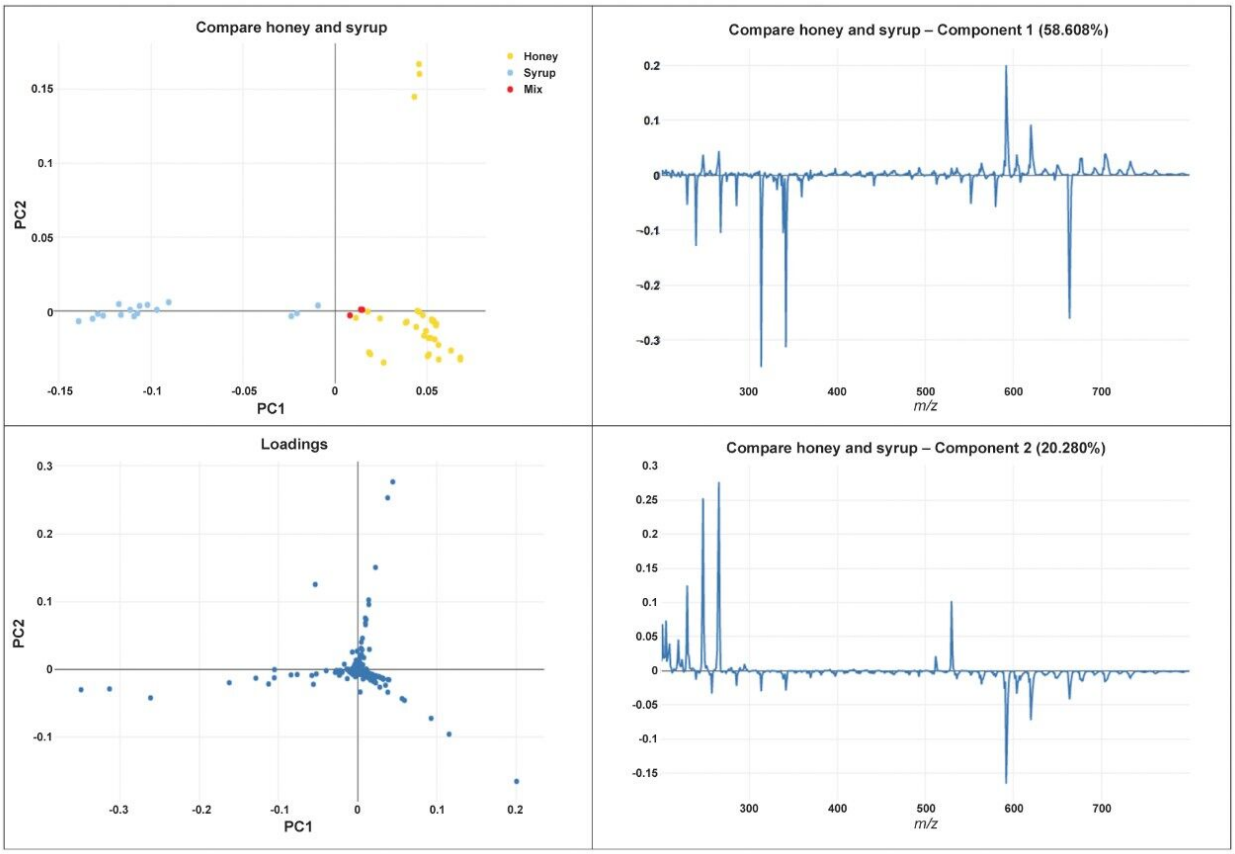

Figure 2. The loading plots of PC1 and PC2 which showed the ions contributed to the difference in principal component analysis.

Conclusion

This proof of principle study using RADIAN ASAP in combination with LiveID Software showed good discrimination of authentic honey, adulterants and honey adulterated with syrup. RADIAN ASAP provides user-friendly operation and time saving discriminant analysis in an integrated platform, which can be used for point of control testing of raw ingredients and finished products as part of food manufacturing process.

Acknowledgements

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