Detection of adulteration in thyme honeys with sugar syrups and colorants using FTIR spectroscopy and chemometrics

Dafni Dimakopoulou-Papazoglou[*a], Nikolaos Ploskas [b], Konstantinos Koutsoumanis [a], Eugenios Katsanidis [a]

[a] Department of Food Science and Technology, School of Agriculture, Faculty of Agriculture, Forestry and Natural Environment, Aristotle University of Thessaloniki, Greece
[b] Department of Electrical and Computer Engineering, Faculty of Engineering, University of Western Macedonia, Greece

Abstract

Honey, renowned for its nutritional attributes and significant commercial value, is susceptible to adulteration on a global scale. This underscores the urgent need for a swift and reliable means of verifying the authenticity of honey. This study aimed to identify adulteration in honey involving the addition of sugar syrups and colorants utilizing FT-IR spectroscopy in tandem with multivariate statistical analysis. The investigation encompassed a dataset of 135 honey samples, of which 77 were commercial thyme honeys gathered from diverse Mediterranean countries (Greece, Spain, Tunisia, and Turkey) and 58 samples of adulterated Greek thyme honey, wherein syrups and colorants had been added. The spectral data were subjected to various preprocessing algorithms, including Savitzky-Golay smoothing, standard normal variate (SNV) correction, and first/second derivative transformations. The subsequent analysis involved Principal Component Analysis (PCA) along with Random Forest (RF) and Data-Driven Soft Independent Modelling of Class Analogies (DD-SIMCA) techniques to discern adulterants within the honey samples. Notably, both one-class (DD-SIMCA) and multi-class (RF) classification methodologies exhibited good performance, achieving an accuracy over 90% for most models. This study demonstrated the potential of combining FTIR spectral analysis with chemometric tools for the fast and effective detection of honey adulteration, particularly through the addition of sugars and colorants.

Keywords: Thyme honey; FTIR; Adulteration; Sugars; Colorants; Chemometrics

Acknowledgments (It must be at most 100 characters): This research is part of the PRIMA programme. Grant agreement No 1932, project MEDIFIT (Call 2019 Sec. 1 Agrofood IA).