CAF Central Analytical Facilities
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Vibrational Spectroscopy Facility

APPLICATION NOTE 02 by Dr Janine Colling

Food connoisseur or cooking amateur, how well do you know you spices?

What is food adulteration and how does it occur ?

The price of herbs is determined by how compact the product is (Black et al., 2016). A common adulterant is therefore the addition of bulking agents such as leaves from other plants. These adulterants often go unnoticed since most herbs are sold dried, chopped and ground (Black et al., 2016). Adulteration of products result in economic and financial losses, it can pose a health threat to the consumers and result in loss of confidence in the product.

Parsley, oregano, thyme or olive leaf ?

Oregano, thyme and parsley are herbs which are frequently used for culinary purposes. Oregano and thyme both belong to the family *Lamiaceae*, whilst parsley belongs to the *Apiaceae* family. Studies have found that olive leaves are commonly used as an adulterant of oregano spice (Marieschi et al., 2010; Bononi and Tateo, 2011). Visually, the roughly ground products appeared distinguishable (Fig. 1). However, when finely ground, few characteristics (except colour) enable the products to be distinguished from each other. In this application note, we tested the ability of NIR hyperspectral imaging to distinguish between authentic spices and an adulterant.

Figure 1: *Fresh and dried spices appear visually distinct.*

Fresh leaves of oregano, thyme, parsley and olive have characteristics that make them recognizable. In a dried and ground state, it is more challenging to identify the products, although they still appear different. Finely ground material have few characteristic properties that can be related back to the original product.

Can HSI distinguish between true spices and the adulterant ?

The finely ground material was imaged with the SWIR camera which collects the spectra in the 950 – 2500 nm spectral range. The average spectra of the various products looked similar (Fig. 2A). Exploratory analysis using PCA showed that the various authentic spices could be separated into four different clusters (Fig. 2B). A PLS-DA calibration can be generated and used for routine screening of samples to verify authenticity of samples. Chemical maps facilitate visualizing chemical differences between samples by means of different colours (Fig. 2C).

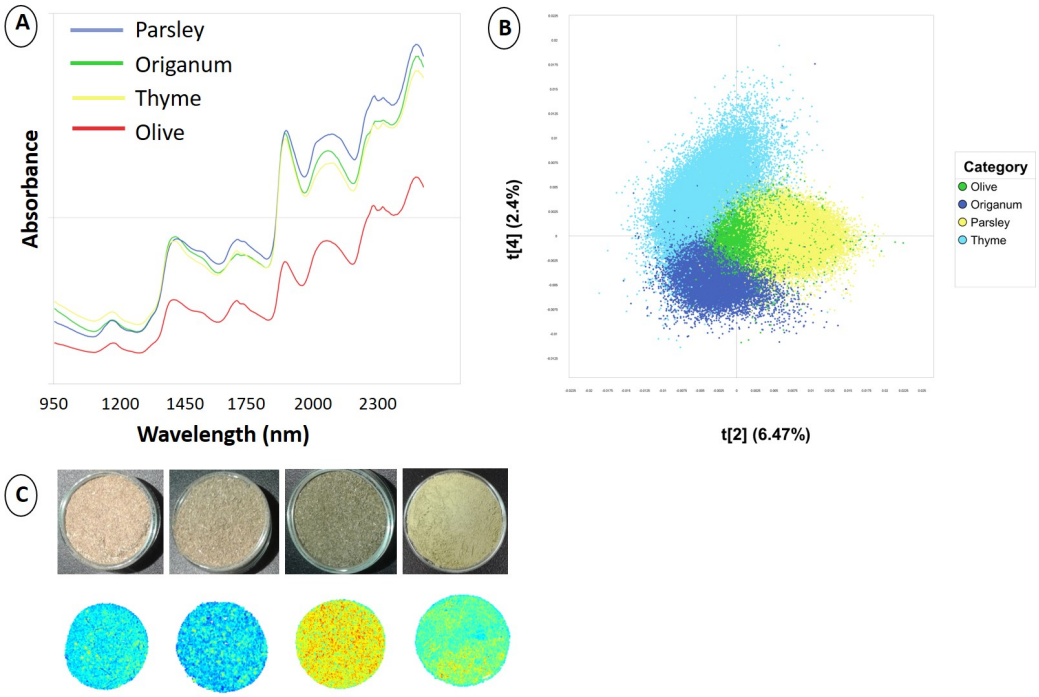

Figure 2: Multivariate data analysis of authentic spices and an adulterant. (A) Spectral plots of spices and olive leaves display similar patterns. (B) Exploratory analysis using Principal component analysis (PCA) can assist with detection of separate clusters for the samples. (C) Chemical maps resemble the chemical differences between the samples. These maps also enable the visualization of the spatial distribution of chemicals within a sample.

How can NIR spectroscopy be used for industrial applications?

- Generate a **classification model** by imaging different authentic materials using NIR equipment to collect the spectra.
- Verify the authenticity of all incoming materials by imaging samples and applying the classification model.
- Other examples of the use of hyperspectral imaging in this industry include assessment of the moisture content in free and packaged oregano (Novo et al., 2016) and analysis of crocin metabolites in saffron (Li et al., 2018).

References for further reading

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Interested in the use of hyperspectral imaging?

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