

HYPERSPECTRAL IMAGING AND PATTERN RECOGNITION FOR DETECTING ADULTERATION IN GOAT CHEESE SAMPLES

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Hyperspectral imaging (HSI) has become an important asset for food authenticity. Some advantages of the HSI when compared to non-imaging devices are related to the spatial distribution information, which enables a better sampling and can increase the sensitivity, being able to detect adulterants below the levels achieved by conventional measurements[1]. Goat cheese is an important food product of the Mediterranean countries with high market value, and usually prone to adulteration. Adulterations with plant-based fat (e.g. palm oil) or animal fat (e.g. cow)' are common issues encountered by regulatory agencies. The aim of this work is to investigate the ability of HSI and pattern recognition tools to detect adulterations in goat cheese samples for authenticity purposes. Authentic goat cheese samples were adulterated with different percentages of palm oil and cow cheese. The samples were imaged using the hyperspectral camera FX10 from Specim (Oulu, Finland), with 5.5 nm of spectral resolution, spectral sampling/pixel equal to 2.7 nm at the range of 400 to 1000 nm (visible/near infrared). Principal component analysis (PCA) was performed and the scores images from PC1 showed differences from the authentic and adulterated samples. The samples with palm oil are related to the absorption around 930 nm (CH₂ bond in fat) while the differences between cow and goat cheese are related to the absorption at 500 nm and 950-1000 nm. Partial least squares regression (PLS) was implemented and compared with multivariate curve resolution – alternating least squares (MCR-ALS) to quantify the adulterants. The MCR-ALS model was able to identify subtle variations of palm oil in the adulterated goat samples, but not in the samples adulterated with cow cheese. The 1 latent variable (LV) PLS model for cow and palm oil adulteration percentage resulted in R²_{pred} of 0.96 and 1.0 and RMSEP of 4.3% and 4.2%, respectively. PLS analysis has given suitable results for the identification of adulterants with higher than 10% of adulteration, showing the potentiality of HSI-VNIR for goat cheese authenticity assessment.

[1] Pasquini, C. (2018). *Analytica chimica acta*, 1026, 8-36.