USE OF NIR SPECTROSCOPY AND RAMAN CHEMICAL IMAGING TO INVESTIGATE THE COMPOSITION OF ANABOLIC TABLETS

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INTRODUCTION

The use of drugs to improve performance is prevalent in professional and leisure sports. Most of these products can be easily purchased in a circuit not monitored by official authorities. The quality of these products without manufacturing control is not guaranteed, and many cases of side effects are reported.

The laboratory of ANSM received regularly such samples from seizures by customs or police. It is interesting to use non-destructive techniques as the first step for unknown products analysis. A spectroscopic investigation on 7 samples of anabolic tablets (labelled with methandienone 5 mg/tablet) has been carried out in order to compare them and to conclude on their composition.

SPECTROSCOPIC METHODS

The near infrared spectroscopy (NIRS) measures molecular vibrations based on C-H, N-H, O-H and S-H overtones and combinations of fundamental mid-infrared vibrations. Chemometric analysis extracts the information of interest.

The Raman spectroscopy detects the inelastic part of the light scattered by a sample irradiated with a laser. The Raman Chemical Imaging technique combines both spatial and spectral information (according a hyperspectral data cube).

Both techniques are complementary as NIRS gives a global fingerprint of the tablet that is very useful for the selection of samples and Raman imaging allows the analyst to observe the distribution of components based on their chemical properties. The methods are qualitative for identification of the chemical substances of the formulation.

Table 1: NIR spectrometer

Make and model	Perkin Elmer Spectrum 100N
Presentation	Diffuse reflection
Spectral range	10 000 - 4 000 cm^{-1}
Resolution	8 cm^{-1}
Number of scan	32
Sampling	7 samples / 10 tablets per sample
Pretreatment of spectra	Normalization SNV
Chemometric method	PCA (Unscrambler X, Camo)

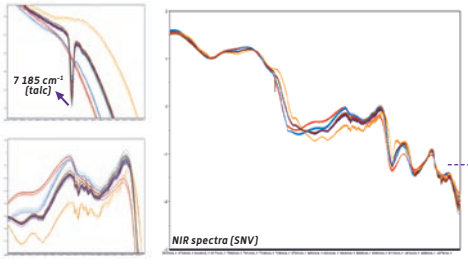
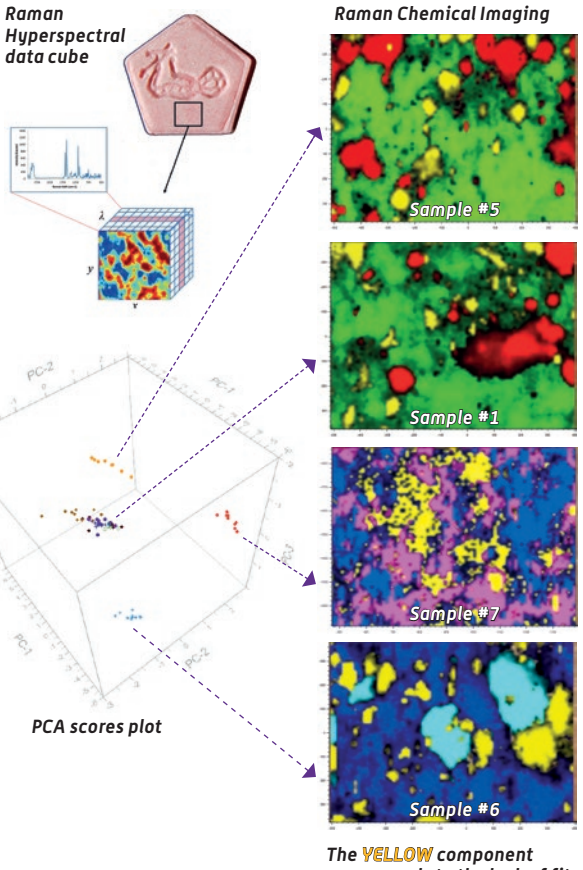


Table 2: Raman spectrometer

Make and model	Renishaw InVia
Spectral range	670 – 1 770 cm^{-1}
Resolution	1 cm^{-1}
Laser	785 nm, 300 mW
Acquisition settings	2 s @ 50% energy
Magnification	20x
Detector	CCD 1024 pixels
Image size	800 x 900 µm
Number of spectra	6 000
Run time	15 min
Pretreatment of spectra	Cosmic Ray Remover
Chemometric method	Multivariate Curve Resolution Alternating Least Square MCR-ALS (Wire 3.4, Renishaw)



RESULTS

NIR spectroscopy assisted by Principal Component Analysis highlights four clusters of spectra in relation with the presence of lactose/starch and talc (thin band at 7185 cm^{-1}). Raman chemical imaging gives a higher level of information with the distribution of chemical substances. MCR-ALS is an unsupervised algorithm which extracts pure components out of the set of 6000 spectra, and thus identifies active substances methandienone/methyltestosterone assisted with a library of spectra. Additional quantitative analysis was performed using chromatographic internal methods.

Samples #1 to #4	Methandienone (5 mg/tablet) Lactose, Talc	
Sample #5	Methandienone (5 mg/tablet) Lactose, absence of talc	
Sample #6	Sucrose, Starch, Talc	
Sample #7	Methyltestosterone (2.5 mg/tablet) Starch, absence of talc	

CONCLUSION

The combination of NIR spectroscopy and Raman chemical imaging allows the analyst to differentiate four different formulations out of seven similar samples of anabolic tablets. Some samples contain an anabolic steroid compound (methandienone or methyltestosterone) and one contains no active substance. The investigated samples are not safe for the health of consumers, because, tablets being of different composition, consumers do not know which chemical substances they really ingest.

Both techniques are fast and non-destructive, and therefore can be carried out as exploratory methods when the number of samples is low or prior to screening destructive methods (e.g. HPLC-MS or GC-MS). They are valuable tools for the analysis of falsified products.

REFERENCES

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