A near infrared (NIR) hyperspectral imaging system running under accreditation ISO 17025 for the detection of Meat and Bone Meal (MBM) in compound feed

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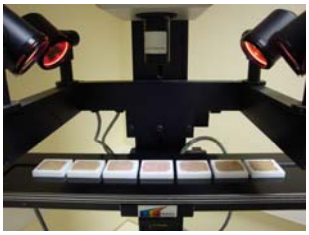
Introduction

The thematic concerned in this study is the **detection of meat and bone animal meals (MBM) in feedingstuffs**. Due to the resurgence of BSE problematic at the end of the nineties, a Council Decision was taken in 2000, which prohibited the use of all meat and bone animal meals for all farmer animals, which were kept, fattened or bred for the production of food. Optical microscopy is the reference method for this analysis. However, near infrared microscopy (NIRM) and near infrared hyperspectral imaging methods have been proposed by the CRA-W as promising alternative methods having decisive and clear advantages (speed, flexibility, easy to use…).

In the framework of the accreditation under ISO 17025 (published by the International Organization for Standardization) various criteria and tests have been considered as the limit of detection, the repeatability and the risk of cross-contaminations. All the criteria and tests considered in this study have driven to a correct validation of the method for the qualitative detection of processed animal proteins in compound feed by near Infrared hyperspectral imaging.

The method is running under accreditation ISO 17025 since 2005 at the CRA-W and is used in the activities of the Community Reference Laboratory for Animal Proteins (CRL-AP).

Hyperspectral NIR system



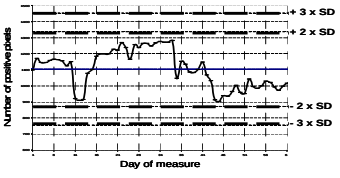
The near infrared camera used in this study is a MatrixNIR Chemical Imaging System (Malvern Instruments, Analytical Imaging, Columbia, MD, USA). Two coupled liquid crystal tuneable filters (LCTF) allow go through sequentially the reflected energy at a defined wavelength range. The LCTF have to be adjusted in order to collect the energy in the 900 nm to 1700 nm spectral range (resolution of 10 nm). After the LCTF, the reflected energy passes goes to an infrared focal plane arrays of size of 240 x 320 corresponding to 76 800 individual infrared detector elements (or pixels). For each pixel, the compilation of the absorbances at each wavelength gives a spectrum. Recent improvements in both the instrument itself and the software (Burgermetrix, Riga, Latvia) have allowed to increase the speed of sample collection. Thus, a moving sample support allows to measure until 12 samples in a continuous way and collects more spectra in an automatic way.

After the samples have been measured with the NIR hyperspectral camera, the spectra obtained have to be studied in order to detect the presence of animal proteins. For this reason, a complete procedure has been developed in order to obtain a fast and reliable method for detecting PAP in feedstuffs using chemometric and visual tools that fulfil the requirements of the ISO 17025 accreditation.

Control chart

A control chart is the tool used to determine whether or not a method is under control. It is useful for ongoing performance validation, and any indication that a method's performance characteristics have declined should be investigated before proceeding further.

The CRA-W proposed to use a standard sample that is measured every day (figure), and the SVM model is applied to determine the number of pixels detected as animal.



Other criteria taken into account (not shown here) are the Limit of Detection (LOD), the possibility of Cross-contamination and the tests of Repeatability (stability test).

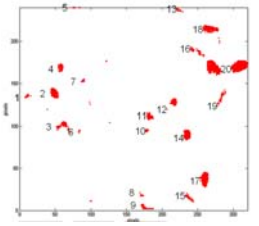
Conclusion

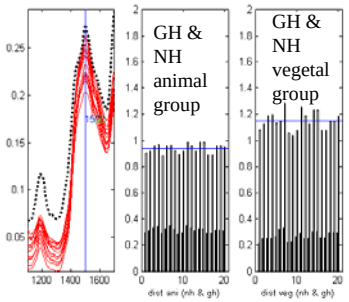
All the criteria and tests considered have driven to a correct validation of the NIR hyperspectral imaging method for the qualitative detection of MBM in compound feed. The LOD (not shown) is about 0.1% and can be even lower by enhancing the number of particles analysed. The control chart showed that for the different days of analysis, the results have always been within the limits allowed and no cross-contamination (not shown) was proved. Moreover the percentage of false positive and negative results is acceptable for a screening method.

Chemometric tools

Support Vector Machines (SVM) is used as chemometric tool for discrimination.

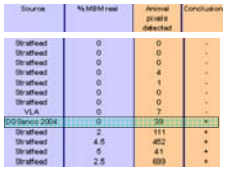
Example of a result obtained for an unknown sample:



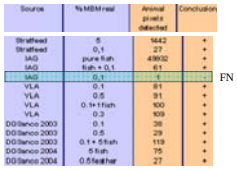


Validation tests

Next table shows the results for some positive (different % of MBM) and negative samples.



FP



FN

* FP: false positive; FN: false negative

References

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2 - A. Michotte Renier, V. Baeten, G. Sinnaeve, J.A. Fernández Pierna, P. Dardenne (2004) 'The NIR camera: a new perspective for meat and bone meal detection in feedingstuffs', *Near Infrared Spectroscopy: Proceedings of the 11th International Conference*, p. 1061-1065. NIR Publications, Córdoba (Spain).
3 - J.A. Fernández Pierna, V. Baeten, P. Dardenne (2006) 'Screening of compound feeds using NIR hyperspectral data', *Chemometrics and Intelligent Laboratory Systems*, 84, pp 114-118.

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Walloon Agricultural Research Centre