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Gembloux

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INTRODUCTION

The mad cow crisis and his socio-economical consequences gave cause for a strict legislative framework for feedingstuffs. The control of the regulations application calls for accurate, precise and fast analytical methods. Detection of animal meat and bone meal (MBM) is usually performed by classical microscopy, which is a reliable but tedious method that highly requires a skilled and experienced analyst.

Since 1998, the Department of agricultural Products Quality has developed an original strategy. FT-NIR microscopy has been used with success for MBM detection and quantification. This method has the advantage to rely only on chemical properties of samples and to be independent of human subjectivity. Whereas this method allows to detect a large number of ingredients in a single analysis, it is not faster than the classical microscopic method. This is why we suggested in 2000 to use a Near Infrared camera (Matrix NIR, from the company Spectral Dimension) (Figure 1).

Figure 1: Camera MATRIX NIR installed at CRAGx.

MATERIAL

The principle is simple: the camera takes sequentially pictures of a pre-defined sample area through a double liquid crystal tuneable filter (LCTF) that selects wavelengths. The operational range of the instrument goes from 900 to 1700 nm. The pictures obtained are collected in a three dimensional matrix, the two first dimensions giving an image and the third dimension giving a spectrum for each pixel of the image. This camera allows the acquisition of 76 800 spectra (Figure 2) within less than four minutes. One can estimate that it corresponds to 400 to 600 particles of meal. The FT-NIR microscopy would need at least three hours to do the same work.

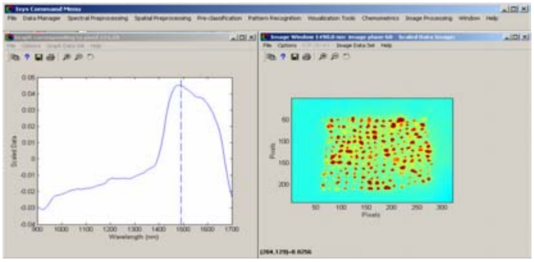

Figure 2: Image at 1490 nm of particules and a spectrum associated to a vegetal particle (position: 124,49).

DATA TREATMENT

The size of each spectral cube file exceeds 24 MB. This amount of information is generated for each data set or each data treatment. One can imagine the necessity of sorting the meaningful information from the background. This is why we wrote a routine in Matlab able to reduce the information into a file containing the identification number, the position and the size as well as the mean of all the spectra of each particle.

The collection of spectral volumes in order to constitute a database is going on. From these data, we have initiated the spectral information treatments by chemometric methods. As preliminary work, PCA has been applied on a spectral cube corresponding to an image containing vegetal and animal particles preliminary identified (Figure 3). The first PCA results (Figure 4) show that the spectral information is of good quality enough to believe in the future reliability of the technique to detect and quantify meat and bone meal. Regression chemometric methods as PLS and ANN will also be tested soon. We plan to apply these methods in an arborescent way of discrimination. The first step should allow us to discriminate animal against vegetal particles, than the second step will concern fish against terrestrial animal particles.

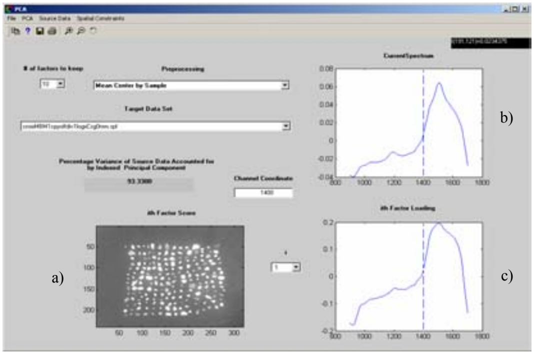

Figure 3: Image of the PCA toolbox showing the 1st principal componant (PC) of a sample (a) as well as the spectrum of an animal particle (b) and the loading associated to the 1st PC (c).

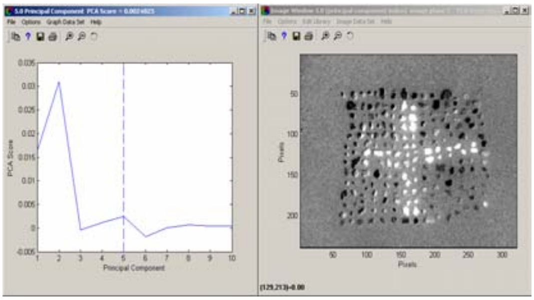

Figure 4: Result of a positive sample: diagram of explained variation associated to the image of the 5ft dimension of principal componant space showing a cross made of animal particles.

CONCLUSION

The first year of this project has demonstrated the feasibility of the detection and quantification of meat and bone meal using a near infrared camera. The advantages of the method are his speed and reliability. One can say that the technical specifications of the camera are not only compatible with our research but will also allow us to have an evolving approach thanks to its flexibility of use. This flexibility lies in the diversity of materials that can be analysed in term of origin, size or texture. The optics can be adjusted by changing lens to make pixels sizes vary between 20 µm and 80 µm. But the flexibility lies also in the ability to export data to Matlab and to develop our own spectral treatment tools.

REFERENCES

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