Near infrared (NIR) hyperspectral imaging at the service of seed quality and safety control

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Introduction




The quality of a seed can be affected by numerous factors, among others infestation by insects, water stress or presence of botanical impurities. In the food sector, certain criteria of quality are visual as the specific purity, the shape, the colour or the absence of exterior damages. Other criteria can be determined only by analyzing the internal part of the seed as the damages by larvae, the pollution by some toxins (mycotoxines), etc … In the seed sector, certain criteria are very important as the purity of variety (no GMO seeds) and seed germination.

Numerous methods have been developed for quality control of seeds, among them: visual examinations of the seeds (colour, shape…), physical tests in laboratories, DNA analyses, protein-based methods or spectroscopic methods.

The seed industry needs automatic methods that require instruments based on objective and consistent criteria to evaluate the quality in real time. Recent researches have shown that the method of near infrared hyperspectral imaging has the potential to be the technology for seed quality control that could contribute in few minutes to supply a complete fingerprint of the analyzed seeds.

Procedure

The instrument used is a MatrixNIR® Chemical Imaging System (Malvern instruments Ltd) recording sequential images with an InGaAs array detector (240x320 pixels) active in the 900-1700 nm range. A total of 76 800 spectra are acquired by area measured.

A mask of the images can be constructed by a process of erosion to determine the contour of every seed. This mask is based on the differences of luminous intensity found in the image. Then, the average spectrum of a seed is calculated by averaging the reflectance of all the pixels for this seed.


Image acquisition

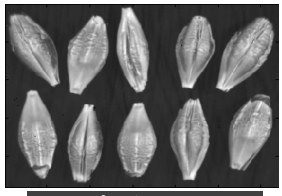
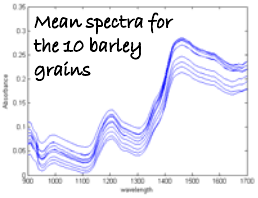
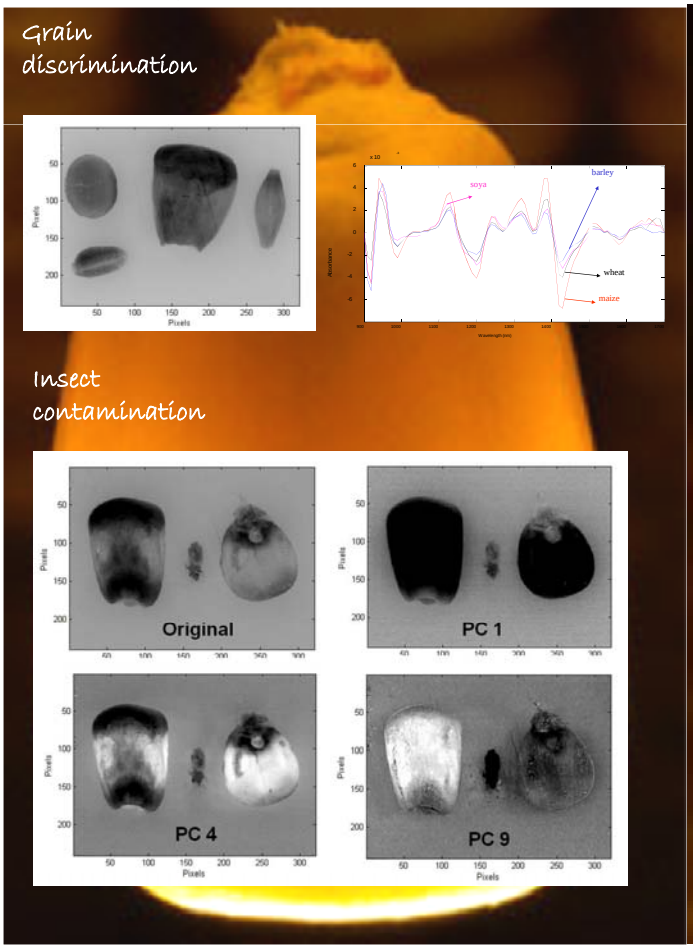


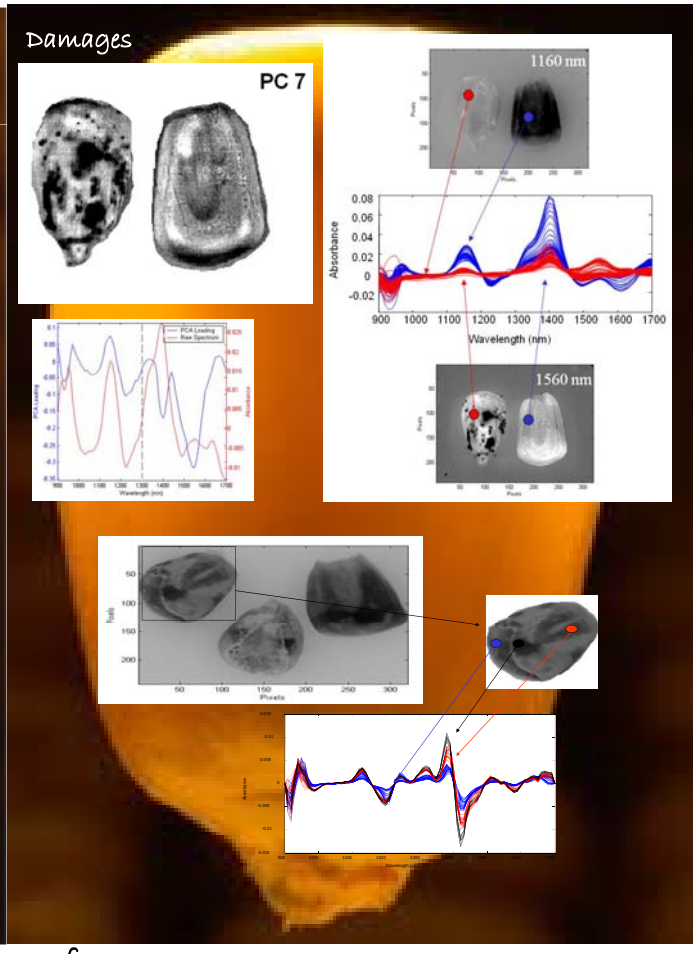
Image of 10 barley grains


Mask on the previous image



Real examples





Conclusion

All the different studies performed until now allowed to demonstrate the promising perspectives of the utilization of near infrared hyperspectral imaging for quality and safety control of cereals.

References

- 'Applications of near-infrared imaging for monitoring agricultural food and feed products'. V. Baeten & P. Dardenne. In Spectrochemical analysis using infrared multichannel detectors. (Rohit Bhargava and Ira Levin eds.) 2005.
-'Hyperspectral imaging techniques : an attractive solution for the analysis of biological and agricultural materials'. V. Baeten, J.A. Fernández Pierna & P. Dardenne. In Techniques and Applications of Hyperspectral Image Analysis, pp. 289-311. (Hans F. Grahn & Paul Geladi Editors, John Wiley & Sons, Ltd.) 2007.
-'NIR Imaging – Theory and applications'. J. A. Fernández Pierna, V. Baeten, J. Dubois, J. Burger, E.N. Lewis & P. Dardenne. In Comprehensive Chemometrics, volume 4, pp. 173-196 Oxford, Elsevier (Steve Brown, Romà Tauler and Beata Walczak eds.) 2009.

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