02-03: Autofluorescence multispectral image analysis at the macroscopic scale for tracking wheat grain tissues: a novel approach for a more specific identification of wheat grain dietary fibre

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Wheat grain contains about 12-14% of fibres mainly located in the outer layers. The composition and the structure of wheat dietary fibres, as well as the nature and amount of co-passengers, vary according to the tissue where they are originated from. The aleurone layer is rich in low substituted arabinoxylans esterified to ferulic acid whereas outer pericarp contains highly substituted arabinoxylans but also cellulose and lignin. Consequently wheat dietary fibres properties showed a high variability according to their tissue of origin within the grain, which deeply impact their nutritional effects. If the identification of tissues in wheat grain is commonly performed, it remains challenging for food ingredient such as mill streams (flour, bran etc).

Equipements are now available to acquire multispectral fluorescence images at the macroscopic scale using filters with specific excitation/emission wavelengths. These fluorescence macroscopes allow obtaining images of a representative number of particles together with a spatial resolution of less than 3 µm. In such images, the intensities measured for each pixel, though they are not spectra, can be assembled to form spectral profiles. To identify the tissular origin from this information, we propose to develop a prediction model on particles using calibration data coming from the observation of tissue sections. This approach is based on several assumptions. The first one is that the multispectral autofluorescence of plant tissues is specific and the second is that it is possible to measure fluorescence intensities in a reproducible way. The objective of the present work was to check the fluorescence macroscope as an efficient device for measuring and comparing fluorescence intensities.

The variability of fluorescence profiles was studied by selecting pixels in cross-sections or in particles mounted in air or in water. The statistical variations were studied by principal component analysis and variance analysis. The first effect, mainly described by principal component 1, was to differentiate aleurone layer from pericarp tissue. The second effect, mainly described by component 2, was a difference between the two mounting media. The differences between sections or powders were not correlated to the other factors and were considered as not significant. Our results show that profiles extracted from multispectral images of cross-sections or particles are similar and allow the identification of wheat grain tissues. If implemented, the prediction from cross-section could be less tedious than other methods requiring dissection and lead to the identification of more tissues. We have demonstrated the proof of concept of tracking wheat dietary fibre origin by predicting tissues on images of particles. This method could help to better qualify flours and various milling fractions as well as to control whole grain products.