Laboratory Scientific Report

Proof of Concept on Tentative Correlation Between Cell Wall Composition and Textural Properties of Sweetpotato Roots

Biophysical Characterization of Quality Traits, WP2

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Ethics: The activities, which led to the production of this document, were assessed and approved by the CIRAD Ethics Committee (H2020 ethics self-assessment procedure). When relevant, samples were prepared according to good hygiene and manufacturing practices. When external participants were involved in an activity, they were priorly informed about the objective of the activity and explained that their participation was entirely voluntary, that they could stop the interview at any point and that their responses would be anonymous and securely stored by the research team for research purposes. Written consent (signature) was systematically sought from sensory panelists and from consumers participating in activities.

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ABSTRACT

For boiled sweetpotato we investigated whether we could identify any relationship between variation in cell wall components and textural measurements... Freeze dried sweetpotato root samples were provided by CIP Uganda and cell walls were prepared from these. The monosaccharide composition of these cell wall samples was determined. In Uganda, the cooking time for these samples had been established previously. No correlation was observed between cooking time and the level of any cell wall monosaccharide. Of particular value in this project, is the use of Fourier Transform infraRed (FTiR) spectroscopy to investigate differences in the degree of esterification of pectin, a major cell wall component. We analysed cell wall preparations from 18 genotypes for which cooking time data were available (from CIP Uganda). Ratio of signals at 1730 / 1625 cm-1 and 1415 / 1235 cm-1 can be used to assess the relative level of pectin methylation. Although there was significant variation in this ratio between the samples from the different genotypes, these was no significant correlation of this parameter with cooking time. Our data indicate clearly that there is no simple correlation between cell wall pectin methylation level or monosaccharide content and textural properties.

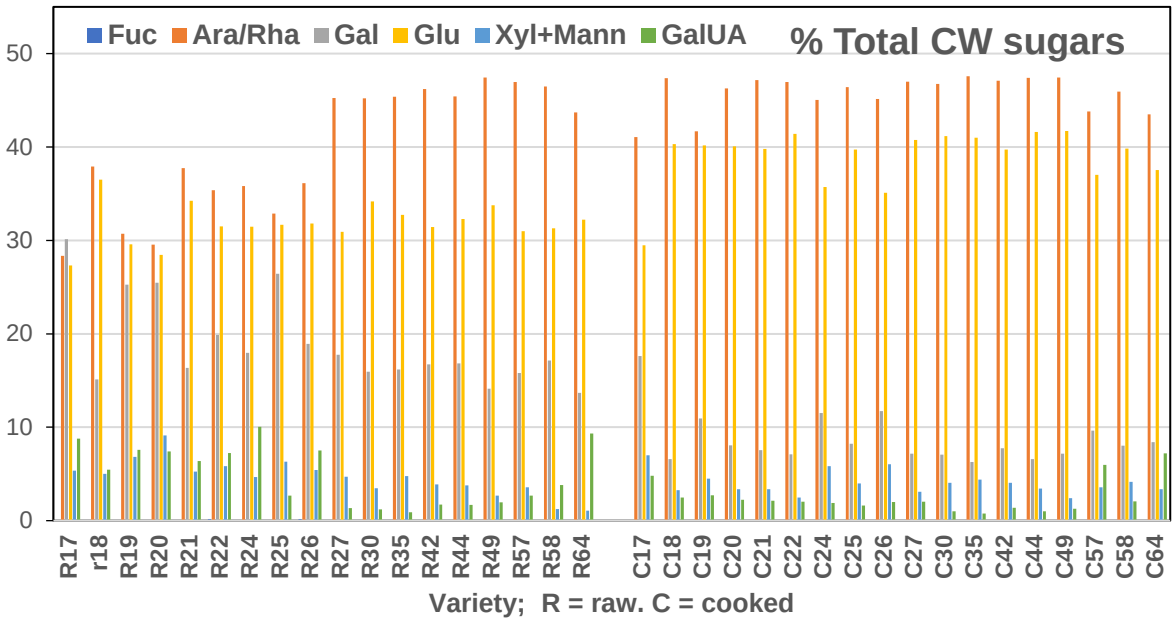
Key Words: boiled sweetpotato, fried sweetpotato, monosaccharide, cell wall, Fourier Transform infraRed spectroscopy

1 MONOSACCHARIDE COMPOSITION OF ISOLATED CELL WALLS

The cell walls of sweetpotatoes (SWPs) have an important role in the development of texture during cooking and influence the textural quality of every major processed sweetpotato product. They are also significant contributors to fibre intake in many diets. The monosaccharide composition of the cell walls of sweet potatoes (or their derived polysaccharides) can be informative about the types and amounts of polysaccharides present. This information can be correlated back to different textural properties noted in different genotypes or varieties.

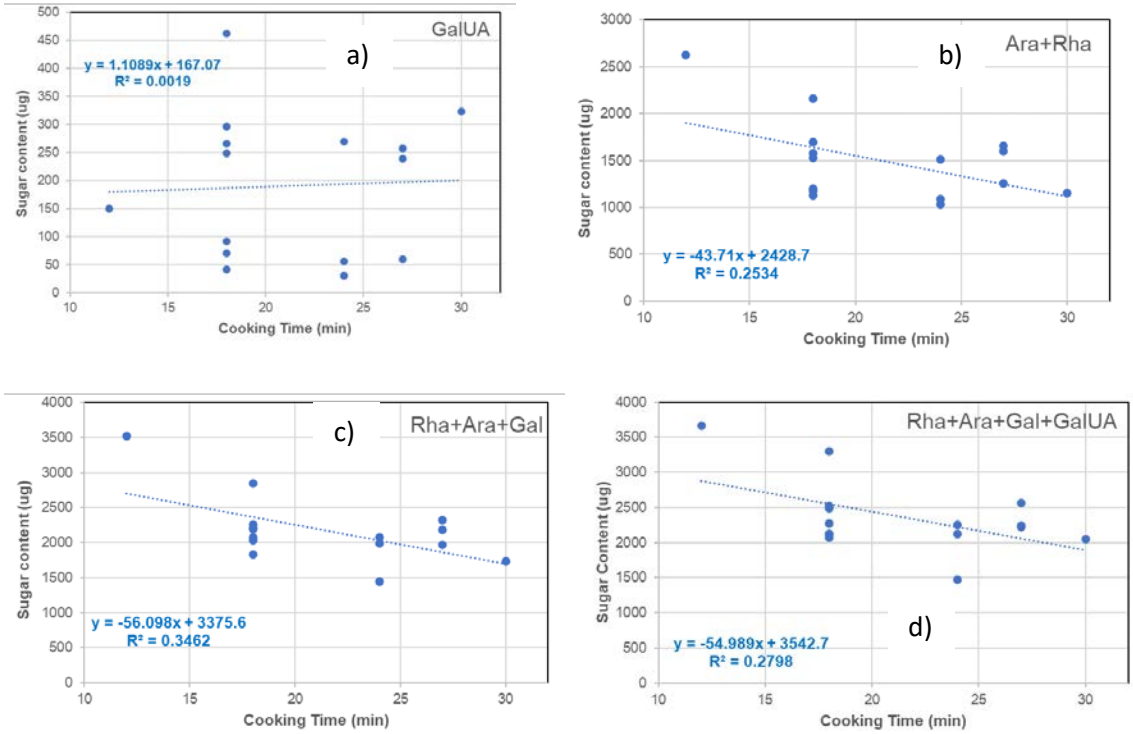
Freeze dried sweetpotato root samples from different genotypes were provided by CIP Uganda and cell walls were prepared from these samples in Period 3. The monosaccharide composition of these cell wall samples was determined by Dionex HPAEC (Fig. 1) in Period 4. The released monosaccharides were as expected from previous studies with substantial amounts of rhamnose, arabinose and galactose and lower amounts of galacturonic acid.

Fig. 1. Monosaccharide composition of isolated cell walls



In Uganda, the cooking time for these samples had been established previously. No correlation was observed between cooking time and the level of any cell wall monosaccharides or indeed any grouping of monosaccharides that could be associated with a particular cell wall polysaccharide. Indeed, the focus was on mixes that could be associated with pectic arabinogalactans (Fig. 2) but none was significant.

Fig. 2. Correlations between cooking time and selected monosaccharide contents of isolated cell wall preparations: a, galacturonic acid, b, arabinose and rhamnose, c, Arabinose, rhamnose and galactose, d, rhamnose, galactose and galacturonic acid content



2 FOURIER TRANSFORM INFRARED (FTIR) SPECTROSCOPY OF SWEETPOTATO ROOT CELL WALLS

FTiR is a powerful and rapid technique for analyzing cell wall components and putative cross-links, which is able to non-destructively recognize polymers and functional groups and provide abundant information about their *in muro* organization. FTiR spectroscopy has been reported to be a useful tool for monitoring cell wall changes occurring *in muro* as a result of various factors, such as growth and development processes, mutations or biotic and abiotic stresses. Of particular value in this project, is the use of FTiR spectroscopy to investigate differences in the degree of esterification of pectin, a major cell wall component.

We analysed cell wall preparations from these same genotypes using Fourier Transform Infra-Red (FT-IR) spectroscopy

Fig. 3 FT-IR spectra of sweetpotato root cell walls (raw)

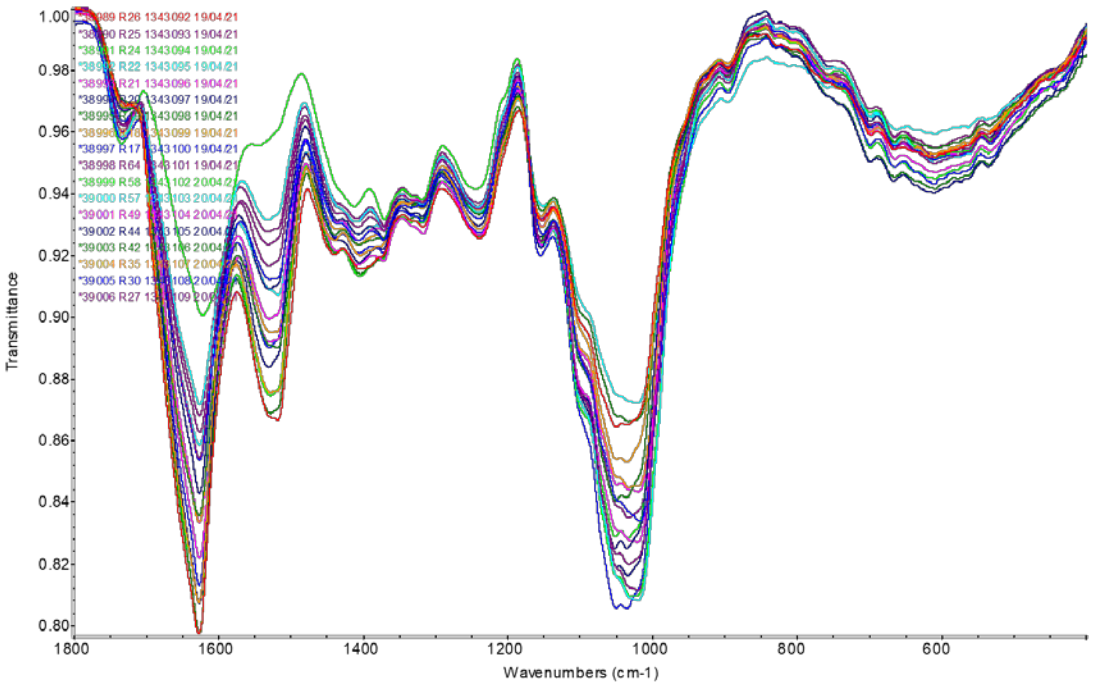
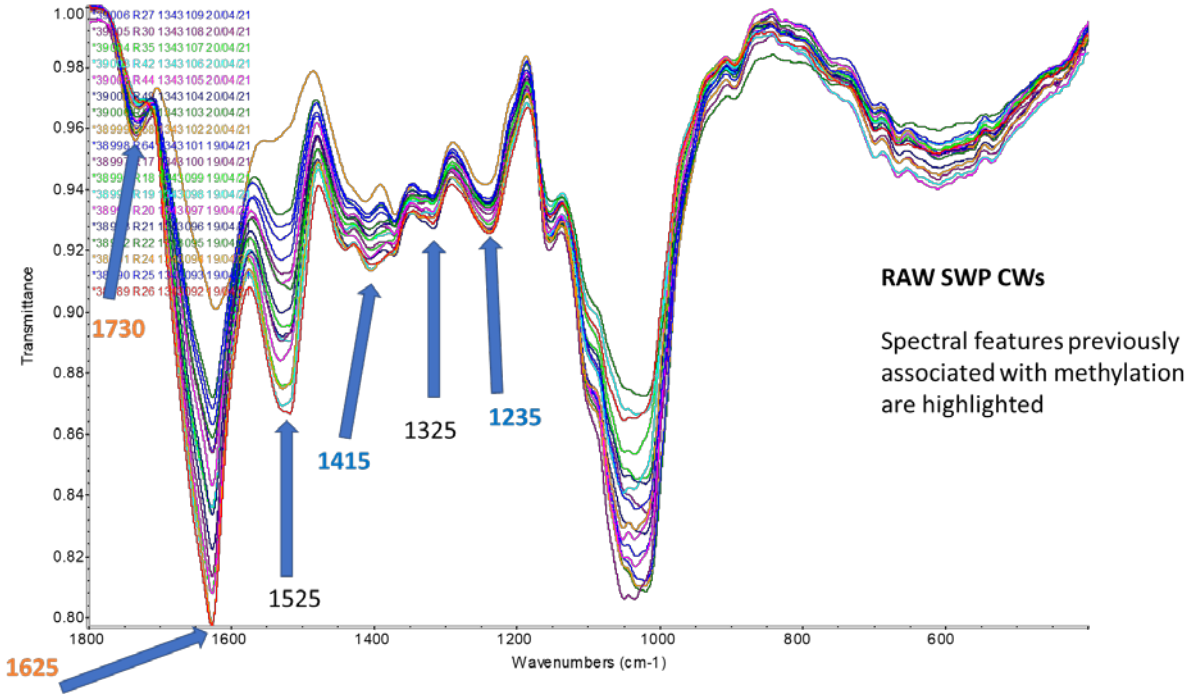
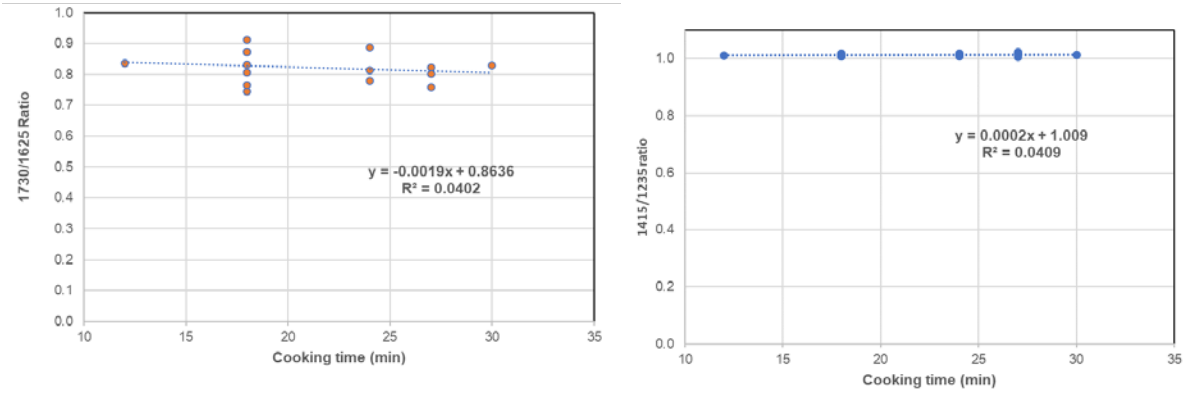


Fig. 4. FT-IR signals associated with methylation status in sweetpotato tuber cell walls



Ratio of signals at 1730 and 1625 cm^{-1} and 1415 and 1235 cm^{-1} have been associated with the degree of pectin methylation in potato cell walls and textural properties of the tubers (Ross et al., 2011). These can be used to discern the relative level of pectin methylation. Although there was significant variation in this ratio between the samples from the different genotypes, there was no significant correlation of these parameters with cooking time (Fig. 5).

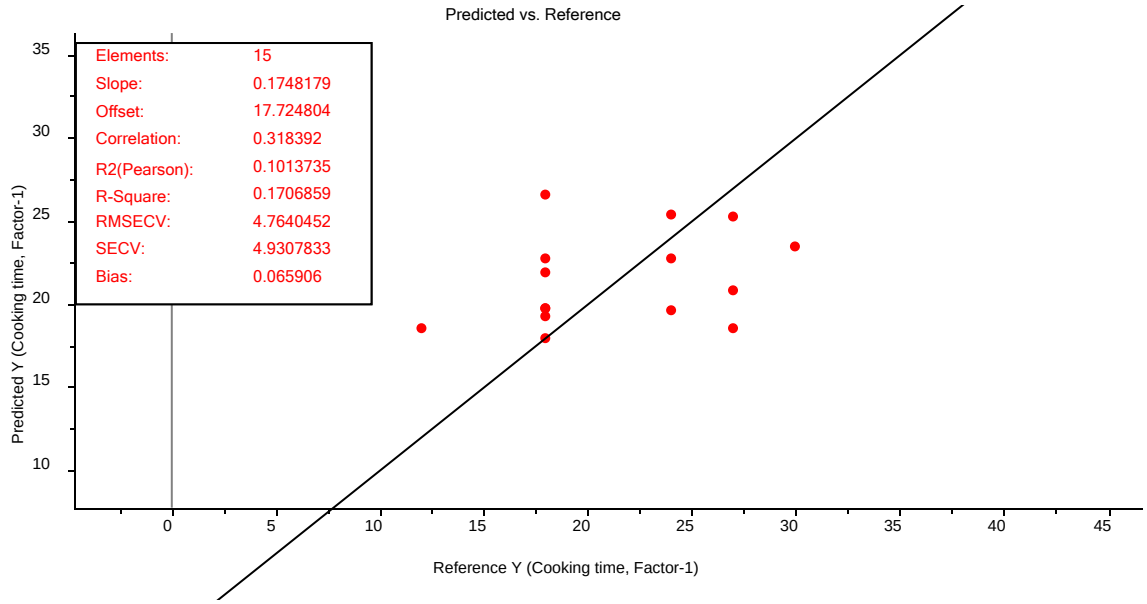
Fig. 5. Correlation of Ratios of FT-IR spectra against Cooking Time



Reference: Ross et al. (2011) Pectin engineering to modify product quality in potato. Plant Biotechnology Journal 9, pp. 848–856 – doi:10.1111/j.1467-7652.2011.00591.x

The FT-IR spectra were also examined for corelations between spectral features and the pattern of cooking time noted for the different genotypes (Fig. 6). No spectral features correlated with the pattern of cooking times noted.

Fig. 6. Correlation of FT-IR spectra against cooking times



3 CONCLUSION

Our data indicate clearly that there is no simple correlation between cell wall pectin methylation level or monosaccharide content and textural properties for boiled sweetpotato. We are currently investigating any correlations between these parameters and fried sweetpotato textural properties.

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