Laboratory Scientific Report

Proof of Concept about Biophysical Bases of Processing and Cooking Ability of Boiled Cassava

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

It is hypothesized that the level and/or structure (particularly the methylation level) of pectins play a major role on the cooking behaviour of RTBs. Hence the need for a medium throughput procedure to assess pectin level and/or structure.

Different extraction procedures (water, addition of Ca++, from 30 to 70°C, from 15 to 120 min, pH 10, EDTA) of pectins have been tested, and released galacturonic acid assessed by colorimetric reaction with meta-hydroxydiphenyl (MHDP) on 6 cassava samples selected for their large range of cooking behaviour. Based on the results, non-methoxylated pectins had a great impact on cooking behaviour of the 6 cassava samples. A relatively rapid procedure of extraction and assessment of methoxylated (pH 10) and non-methoxylated (EDTA 0.05 M) pectins can be used to predict cooking behaviour. A procedure using a continuous flow analyser has been developed for rapid analysis of extracted galacturonic acid.

The next step is to analyse a large number of cassava samples and to test the procedures on other RTBs of the project (yam, sweet potato, and banana).

Key Words: cassava, cooking time, water absorption, rheology, pectins, EDTA, colorimetry

6 cassava samples having cooking time from short (by 20 min) to high (over 60 min) with low (10^6 Pa) to high ($5\ 10^6$ Pa) storage modules (G') after 10 minutes of cooking (Figure 1) have been used to test pectins extraction procedures and relationship with cooking behaviour.

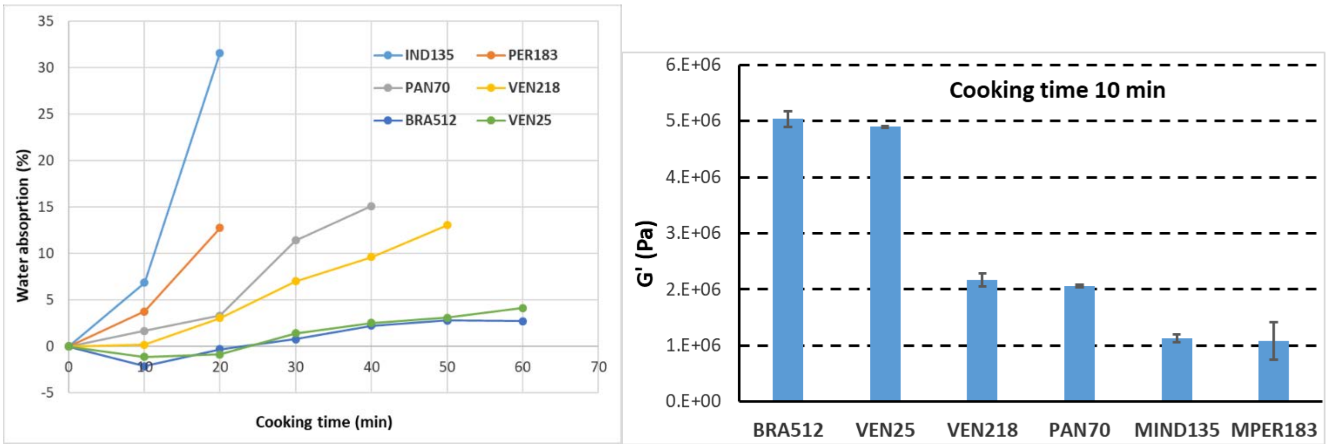

Figure 1 Water absorption kinetic during boiling (a) and storage modulus measured after 10 min of boiling (b) of the 6 cassava samples

Different extraction procedures have been tested, and released galacturonic acid assessed by colorimetric reaction with MHDP (meta-hydroxydiphenyl), using a continuous flow analyser (Figure 2).

Figure 2 Continuous flow analyser used to assess galacturonic acid

The results show that:

- The addition of Ca^{++} in the extraction medium, that can favour ionic linkages between pectin chains does not significantly reduce the extraction yield (Figure 3a); it is thus not necessary to add Ca^{++} to specifically extract methylated pectins,
- At the opposite, the addition of EDTA, that can complex Ca++, multiply extraction yield by 5 (Figure 3b); an optimum of 0.05 M EDDTA has been observed,

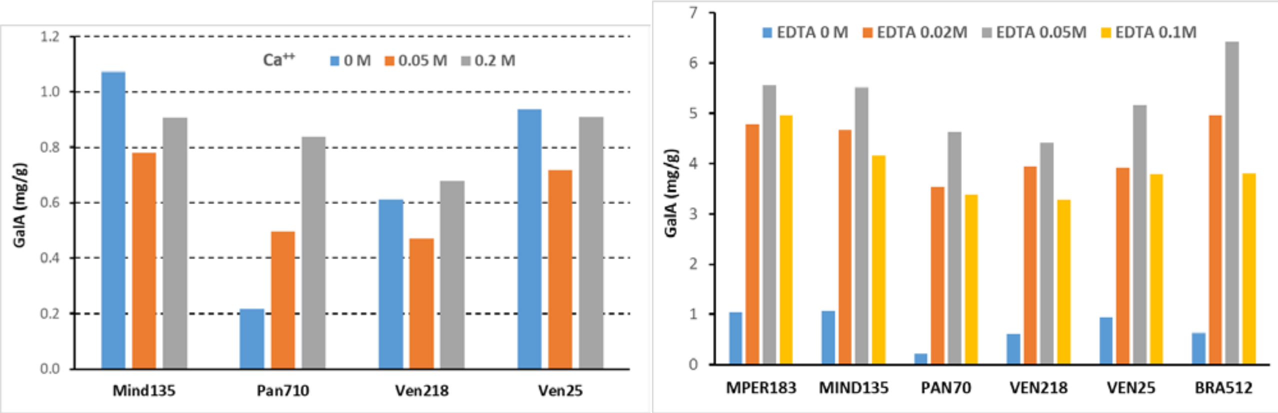

Figure 3 Galacturonic acid released after extraction at 55°C for 60 min with various levels of Ca++ (a) or of EDTA (b) for the cassava samples

- hot extraction temperature increases extraction yield, but is influenced by the temperature of starch gelatinisation (between 55 and 75°C) (Figure 4a); an extraction at 50°C has thus been selected,
- a duration of extraction of 60 minutes appears sufficient (Figure 4b),

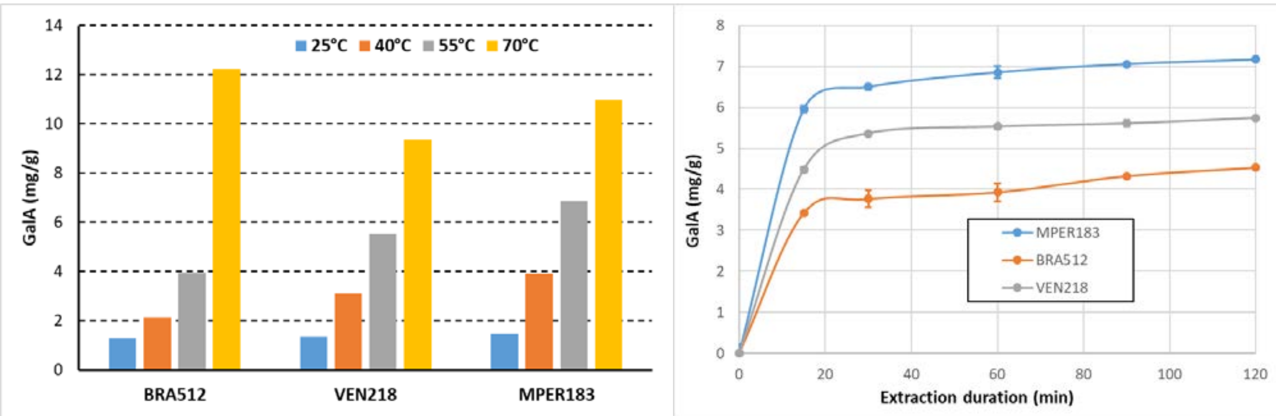

Figure 4 Galacturonic acid released after extraction at various temperature for 60 min (a) or at 55°C for various durations for the cassava samples

- the mass/volume ratio has a significant impact on extraction yield at pH 10 (Figure 5a), and in presence of EDTA (Figure 5b); a mass/volume ratio of 0.01 has been selected,

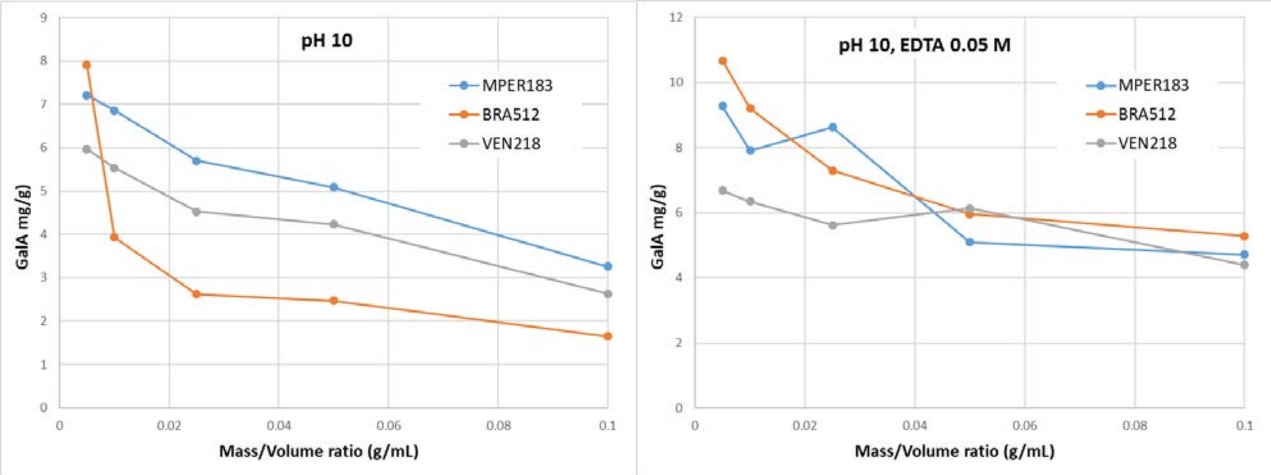

Figure 5 Galacturonic acid released after extraction at pH 10 (a) or pH 10 + EDTA (b) for various mass/volume ratio

Results of pectin extraction for the 6 cassava varieties clearly (Figure 6) show that:

- water extraction at 55°C is insufficient to quantitatively extract pectins and extraction yields in water are not correlated with texture (Figure 7a),
- addition of EDTA 0.05 M multiply the extraction yield of at least 5, but no clear relationship between with texture can be evidenced (Figure 7a)
- however, extraction yields at high pH (10) is highly significantly negatively correlated with texture (Figure 7b); cassava with high content of methoxylated pectin (extracted by beta-elimination at pH 10) have lower firmness and cooking time,
- addition of EDTA at pH 10 dramatically increases pectin extraction yield for bad cooking cultivar (Ven 25 and Bra512), thus evidencing the higher level of non-methoxylated pectins in these varieties (Figure 6). The increase of released galaturonic due to EDTA was thus highly significantly positively correlated with texture (Figure 7b)

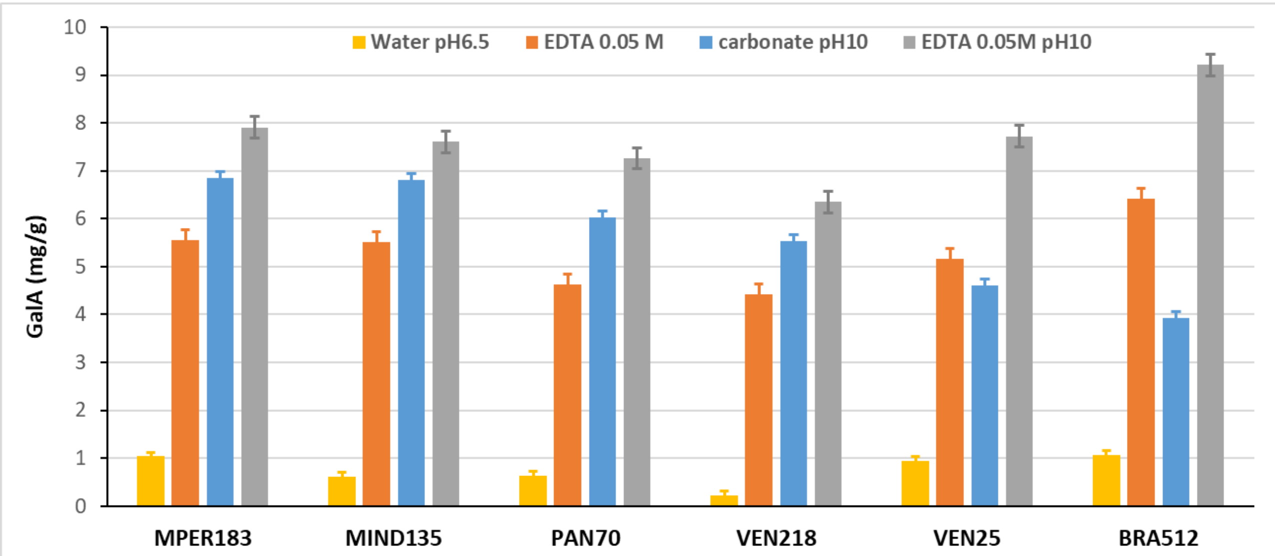

Figure 6 Galacturonic acid released after extraction at pH 10 (a) or pH 10 + EDTA (b) for various mass/volume ratio

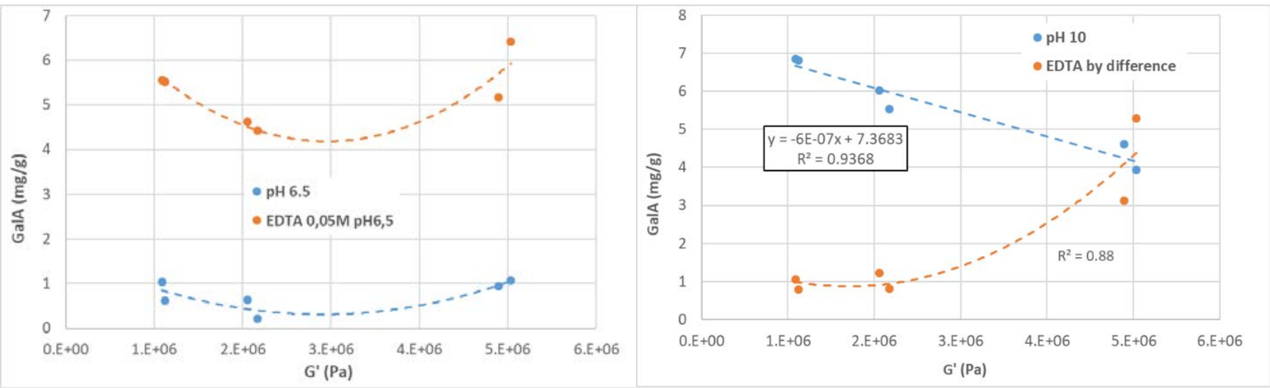

Figure 7 Relationship between released galacturonic acid and storage modulus (G') after cooking; extraction at 6.5 and EDTA (a), pH 10 and difference between pH 10 + EDTA and pH 10 (b) for the 6 cassava samples

It has thus been demonstrated that non-methoxylated pectins have a great impact on cooking behaviour of cassava. A quite rapid procedure of extraction and assessment of methoxylated (pH 10) and non-methoxylated (EDTA 0.05 M) pectins can be used to predict cooking behaviour.

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