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Banana plantain functional properties evaluation during water cooking processes: a NIRS original assay and perspectives

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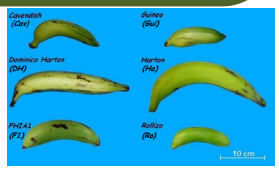
Starch is the major component of edible banana at green stage of maturity, and is well-known to highly contribute to its functional properties. Among others, near-infrared spectroscopy (NIRS) have already been successfully applied to evaluate native starch functional properties.



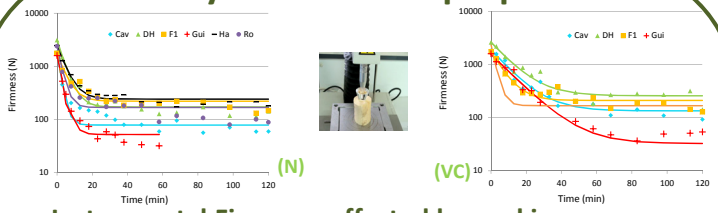
Material and methods

An assay was carried out to differentiate the cooking behavior of 6 banana genotypes from Colombia. Cylinders of pulp were cooked in boiling water (N), and also vacuum sealed in heat-resistant pouches prior to cooking (VC). At various cooking time intervals, pulps removed from the water bath were submitted to instrumental firmness prior to drying at 40°C. The properties of the flours were evaluated by reference methods: DSC (onset, ΔH), RVA (pasting temp. PT, hot paste viscosity HPV, cooking ability CA), dry matter content (DM) and NIRS.

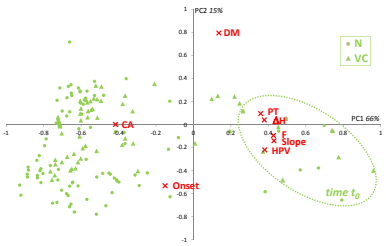
water cooking (N)

vaccum sealing & water cooking (VC)

Physicochemical properties

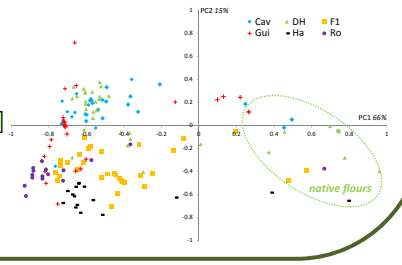


Instrumental Firmness affected by cooking process



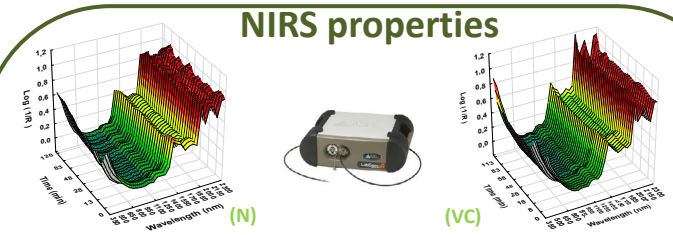
- PC1 positively correlated to RVA parameters PT, slope & HPV, firmness and negatively to CA
- PC2 correlated to dry matter & onset
- Cooking time t_0 discriminated on PC1

Biplot ACP with scores and loadings

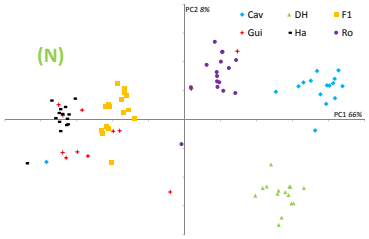


- Varieties discriminated on PC2 (Ha, Ro and F1 *versus* Cav and DH)
- Good discrimination of native flours on PC1

NIRS properties

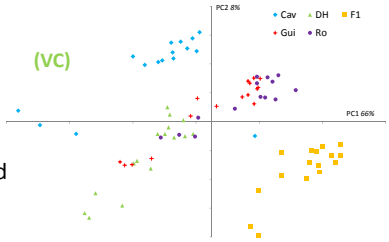


NIR spectra acquired in reflectance mode



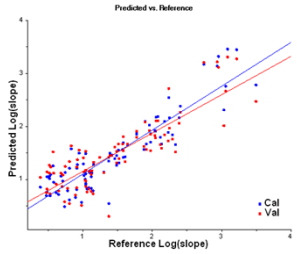
NIRS ACP scores: PC1 correlated to 1st overtone of hydroxyl groups of starch (1412 *n*m). PC2 correlated to starch crystallinity (1934 *n*m) for N samples.

NIRS ACP scores:
PC1 and PC2 also correlated to hydroxyl groups and crystallinity of starch. An additional wavelength in relation to crystallinity was observed at 1929*n*m for VC samples.



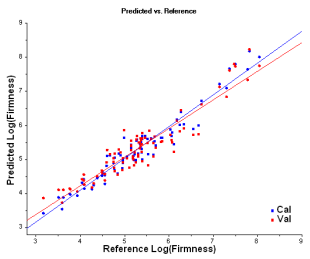
- Each variety has a specific cooking behavior
- Whatever the cooking process, NIR spectra helped to differentiate varieties

NIRS prediction of physicochemical properties



	Calibration and internal cross validation					
	min-max	N	deriv.	SEC	R^2cal	SECV
Pasting Temperature (PT) °C	58.2 - 79.5	90	2	2.52	**0.69**	2.72
Log(HPV) cP	Log(495) - Log(2578)	90	2	0.21	**0.76**	0.29
Cooking ability (CA) min	202 - 956	91	2	0.65	**0.76**	0.72
Log(slope) $cP.s^{-1}$	Log(1.48) - Log(33.06)	91	2	0.32	**0.82**	0.40
Log(Firmness) N	Log(18.2) - Log(3143.4)	90	2	0.26	**0.93**	0.36

deriv. level of derivative applied on spectra; SEC Standard Error of Calibration; SECV Standard Error of Cross Validation



Conclusion and perspectives

The factorial map highlighted some crossed-effects of the cooking mode and varietal contribution, making possible to distinguish both processes and genotypes. Results of PLS modeling indicated that NIRS was accurate in predicting some RVA parameters (PT, HPV, CA, slope) and Firmness with good coefficients of determination (R^2cal = 0.69-0.93). Surprisingly, near infrared spectra were able to predict properties measured on the freshly cooked material (Firmness), although the NIR measurements were carried out on flours. Such rapid predictive methods applied on native or even cooked flour samples can contribute to routinely predict the cooking behavior of the banana starchy resources in breeding programs.

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