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1 - Processing and reactivity of F&V

O1.6 - Role of apple flesh mechanical properties in juice production

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Apple processing for juice production suffers from yield variability due to varietal, physiological and post-harvest handling factors. In order to identify markers to be used by the profession to class fruit lots and adapt process, a study was engaged on the contribution of apple cell wall on the viscoelastic mechanical properties of desert and cider varieties.

As turgor pressure is the major contributor to apple flesh firmness, mechanical properties were measured by Dynamic Mechanical Analysis (DMA) on fresh and plasmolyzed tissue. Groups of varieties were identified on the basis of the impact of plasmolysis on the residual viscoelastic properties (storage modulus E' and tanδ). Insights in the cell wall structure and organization was obtained by solid state ^{13}C NMR spectroscopy using a variable contact time CPMAS (VCT-CPMAS) experiment and modeling of signals intensity with regard to magnetization transfer time.

The $T_{1\rho}$ relaxation time of the proton attached to C4 of cellulose taken as a probe of cellulose organization showed a clear correlation with E' of fresh apple flesh which indicated that tightly packed cellulose fibrils in the cell wall are unfavorable for flesh firmness. The magnetization transfer time from neighboring proton (mainly from water) to pectin methyl ester protons also demonstrated a correlation with E' indicating that pectin hydration plays a major role on fruit viscoelastic properties. Both DMA and NMR results are in support of a poro-viscoelastic type mechanical properties of apple flesh in which water in the porous cell wall network contribute to the fruit firmness [1]. Relation between cider apple juice yield obtained by an experimental press with viscoelastic mechanical properties of fresh and plasmolyzed fruit collected at different levels of maturity showed that relation could be obtained only from fresh fruit E'.

If there is a global positive trend between fruit firmness and juice yield, better relations were obtained according to varieties. Thus, mechanical properties of apple flesh represent a weak indicator of juice yield and other dominant genetically dependent structural factors are likely involved.

Keywords: Cell wall, cellulose, pectin, DMA, NMR

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