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Apple cell wall contribution to fruit viscoelastic properties

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Fleshy fruit quality relies on various characters among which texture impact, production, processing and consumer acceptance. To date, texture is still poorly controlled as structural, physicochemical and mechanical factors are yet to be fully identified and their mechanisms of variation elucidated. Fruit texture implies viscoelastic mechanical properties of parenchyma tissue that result from tissue microstructure, water content and compartmentation, and cell wall mechanical properties. The latter depends on the structure and organization of pectin, hemicellulose and cellulose which individual contribution to the elastic (E') and to the viscous ($\tan \delta$) mechanical characteristics remains to be established.

With Golden Delicious and Granny Smith apple parenchyma tissue as models, the contribution of the different cell wall polysaccharides to viscoelastic properties was assessed after infusion of specific pectinases, hemicellulases and cellulases in an osmoticum to control turgor pressure. The results showed that both the viscous and elastic properties are linked ($\Delta \tan \delta / \tan \delta \approx -\Delta E' / (2E')$) and that all cell wall polysaccharides contribute to both the viscous and elastic characteristics. Enzyme hydrolysis sensitivity test showed that homogalacturonan pectic domain plays a major role on the parenchyma tissue viscoelastic properties. Fucosylation of xyloglucan and crystalline cellulose were also identified as cornerstone structures for parenchyma viscoelastic properties. These key cell wall structures may prove to be interesting targets to develop new textured fruit products.

Keywords: apple, cell wall, mechanical properties, enzymes.