# Nanostructural changes in cell wall pectins during strawberry fruit ripening assessed by atomic force microscopy

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Rapid loss of firmness occurs during strawberry (*Fragaria* × *ananassa* Duch) ripening, resulting in a short shelf life and high economic losses. The disassembly of cell walls is considered the main responsible for fruit softening, being pectins extensively modified during strawberry ripening (Paniagua et al. 2014). Atomic force microscopy allows the analysis of individual polymer chains at nanostructural level with a minimal sample preparation (Morris et al., 2001). The main objective of this research was to compare pectins of green and red ripe strawberry fruits at the nanostructural level to shed light on structural changes that could be related to softening.

Cell walls from strawberry fruits were extracted and fractionated with different solvents to obtain fractions enriched in a specific component. The yield of cell wall material, as well as the amount of the different fractions, decreased in ripe fruits. CDTA and $Na_2CO_3$ fractions underwent the largest decrements, being these fractions enriched in pectins supposedly located in the middle lamella and primary cell wall, respectively. Uronic acid content also decreased significantly during ripening in both pectin fractions, but the amount of soluble pectins, those extracted with phenol:acetic acid:water (PAW) and water increased in ripe fruits. Monosaccharide composition in CDTA and $Na_2CO_3$ fractions was determined by gas chromatography. In both pectin fractions, the amount of Ara and Gal, the two most abundant carbohydrates, decreased in ripe fruits. The nanostructural characteristics of CDTA and $Na_2CO_3$ pectins were analyzed by AFM. Isolated pectic chains present in the CDTA fraction were significantly longer and more branched in samples from green fruits than those present in samples obtained from red fruit. In spite of slight differences in length distributions, $Na_2CO_3$ samples from unripe fruits displayed some longer chains at low frequency that were not detected in ripe fruits. Pectin aggregates were more frequently observed in green fruit samples from both fractions. These results support that pectic chain length and the nanostructural complexity of the pectins present in CDTA and $Na_2CO_3$ fractions diminish during strawberry fruit development, and these changes, jointly with the loss of neutral sugars, could contribute to the solubilization of pectins and fruit softening.

Paniagua et al. (2014). Ann Bot, 114: 1375-1383
Morris et al. (2001). Food Sci Tech 34: 3-10

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