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Fruit Cell Walls, Texture and Convenience.

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The walls of fruit cells play an important part in determining the texture of fleshy fruit and their eventual acceptance by consumers [1]. This involves both the mechanical properties of the walls and their adhesion to neighboring walls. During fruit ripening and softening, structural and chemical changes occur in the cell walls that result in textures characteristic for each particular fruit.

We have been studying changes in fruit cell walls using a combination of mechanical testing, low temperature scanning electron microscopy, and immunolocalization of cell wall polysaccharides in a range of fruits, and in kiwifruit in particular [2]. Kiwifruit undergo an unusually high degree of wall swelling during ripening which appears to be related to pectin solubilization [3]. However, close examination of the parenchyma cells of outer pericarp tissue has shown that some wall regions retain the characteristics of unripe tissue throughout the ripening process (Fig. 1).

One resistant region is the cell wall immediately adjacent to plasmodesmatal connections between cells (plasmodesmatal pit fields). These regions, in a range of ripening fruits, show little change in physical appearance, staining and antibody labeling of polysaccharides as the fruit softens. However, in firm unripe tissue they often do show some differences from other regions of the cell wall. For example, with some antibodies (e.g., LM5 antibody to (1→4)-β-D-galactan) they may show reduced staining.

The outer pericarp tissue of kiwifruit is primarily composed of parenchyma cells falling into two populations; large cells with a maximum dimension from 0.5 to 1 mm, and small cells up to 0.2 mm. The cell wall of the large cells is the other region that shows resistance to softening. These cells comprise around 42% of the volume of the outer pericarp but their cell walls contribute under 20% to the total cell wall volume. In firm unripe tissue these cells stain/label in a similar way to adjacent walls of smaller cells. However as the smaller cells lose their ability to stain and label during ripening the larger cells remain unchanged. In ripe to over-ripe tissue it is relatively simple to extract these larger cells intact from the degraded cell wall tissue of the smaller cells.

Variations in the patterns of cell wall degradation, as expressed by differential labeling by antibodies to pectins, may also be important in the ability of the kiwifruit skin to be peeled. Commercial kiwifruit are relatively unpeelable and have an unpalatable skin, both characteristics that reduce their convenience to consumers. Some related species have much better peelablity. This characteristic is related to the ability of cells of the outer pericarp to separate from each other intact. Improved skin detachability is associated with a lower frequency of ruptured cells. Although there appears to be little structural difference between fruit with good and poor detaching skins there is a difference in the distribution of certain pectin epitopes in homogalacturonan pectin (that identified by the JIM5 antibody) and rhamnogalacturonan I pectin (that identified by the LM5 antibody). Skins showing good detachability have a sharper transition from higher levels of these pectins near the skin to lower levels or absent in the outer pericarp (Fig 2). [4]

[1] Harker, F.R. et al., *Hortic Rev* 20 (1997)121.
[2] Sutherland, P. et al., *Int J Plant Sci* 160 (1999) 1099.
[3] Redgwell, R.J. et al., 1997. *Planta*, 203 (1997) 162.
[4] This work was supported by the New Zealand Foundation for Research, Science and Technology.

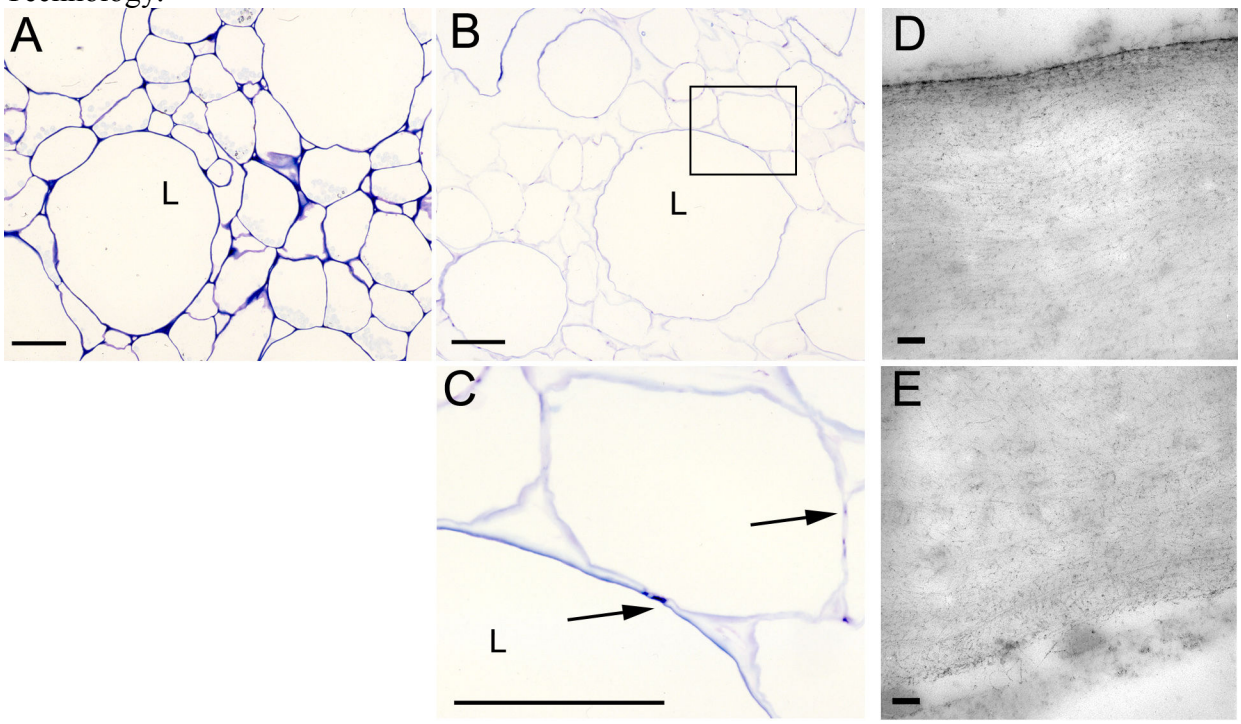

Fig. 1. Sections of outer pericarp of kiwifruit, A. firm and B-E ripe/soft. A-C light microscope sections stained with toluidine blue B, C show retention of staining in cell walls bounding large cells (L) and in plasmodesmatal pit field regions (arrows). D, E TEM sections stained using the periodate/thiosemicarbazide/silver proteinate technique. D. wall adjacent to large cell, E. wall adjacent to small cell. Scale bar A-C = 100 μm, D, E = 100 nm

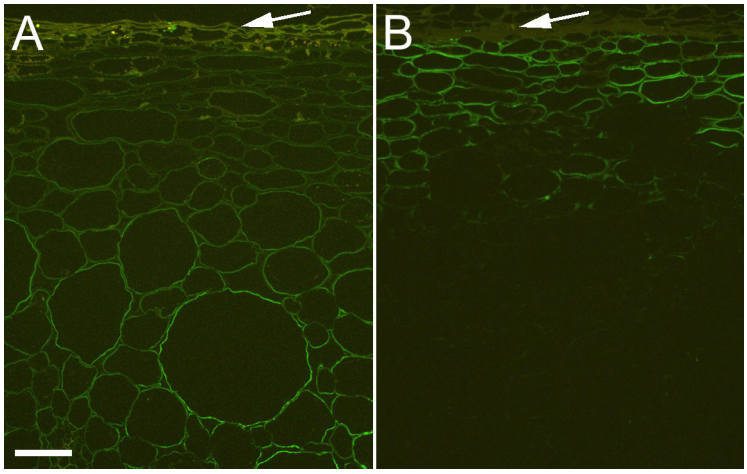

Fig. 2. Sections of ripe "kiwifruit" with differing skin detachment properties labeled with the LM5 antibody to (1→4)-β-D-galactan. Section extends from the skin (arrows) to the outer pericarp. A. poor detaching 'Hayward', B. good detaching hybrid. Scale bar = 100 μm.

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