Differences in the cell morphology and microfracture behaviour of tomato fruit (*Solanum lycopersicum* L.) tissues during ripening

Zhengguang Liu, Zhiguo Li, Tianli Yue, Elien Diels and Yougang Yang

Postharvest Biology and Technology, Volume 164, June 2020, 111182

Abstract

Fresh tomato fruit (*Solanum lycopersicum* L.) is very susceptible to microdamage during post-harvest handling. This study reveals the differences in 3D cell morphology (e.g., shape, size, arrangement, and wall thickness) and microfailure behaviour of different tissues in the tomato fruit. At each ripening stage, the 3D shape, size and arrangement of cells in different tissues of a tomato fruit were investigated based on two microscopic orthogonal images. Additionally, the cell wall thickness was determined using transmission electron microscopy, and the microfailure mode of each tissue under shear and tension was quantitatively assessed based on the cell rupture rate in the crack growth path. The cells in different tissues of a tomato fruit showed obvious differences in the 3D shape and growth direction. Septa cells had the largest sizes. Cell wall thickness was closely associated with fruit ripeness and tissue type. Epidermal cell walls in the pink exocarp were the thickest compared with the other tissue cell walls. The cell rupture rate was dependent on the fruit ripening stage, the type of tissue and the direction/mode of the applied force ($p < 0.05$). Two failure modes, namely, cell rupture and separation, were observed in the different tissues of the tomato fruit at each ripening stage under shear and tension. This work provides a vital basis for modelling and simulating microscopic mechanical damage experienced by fresh tomato fruits due to excessive external forces during post-harvest handling.