

Abstract

Harvested broccoli and asparagus exhibit delayed senescence during controlled atmosphere (CA) storage. To understand the key biochemical steps involved in this process, we measured the content of three glycolytic metabolites, the activities of sucrose-metabolising and glycolytic enzymes, and intracellular sugar concentrations by efflux analysis in asparagus spear tips and broccoli branchlets during storage in air or CA (5% O₂, 10% CO₂). Glucose-6-phosphate (G6P)/glucose-1-phosphate (G1P) ratios fell in both commodities following air storage but were maintained close to harvest values by CA, whereas glucose-6-phosphate/fructose-6-phosphate (F6P) ratios remained close to harvest values in both air and CA. In asparagus, CA storage maintained the activity of several sugar metabolising enzymes at, or above, harvest levels compared with air storage, where activities fell. CA also abolished the air-induced increase in acid invertase activity. There were significant differences in the pool sizes of sugars in the different compartments (vacuole, cytoplasm, free space) of asparagus and broccoli, with asparagus having a very low cytoplasmic glucose and fructose concentration. Broccoli stemlets had the highest glucose and fructose concentration in each compartment. CA led to a more rapid fall in vacuolar fructose concentration in asparagus and a greater consumption of vacuolar sucrose in broccoli. The other vacuolar sugar concentrations that we measured did not change significantly in air or CA in asparagus or broccoli. CA storage also resulted in a lower concentration of glucose in the free space of asparagus and sucrose in the free space of broccoli. Collectively, these results show that different perishable vegetable crops respond differently to CA. Asparagus in CA appeared to engage the ethanolic fermentation pathway and broccoli appeared to engage both the lactic and ethanolic fermentation pathways, but only transiently. CA may have permitted more controlled use of whichever vacuolar sugar the tissue normally drew upon (fructose in asparagus, sucrose in broccoli) and delayed an increase in plasma membrane permeability.